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TREATMENT OF FRACTURED NECK OF THE FEMUR WITH ESPECIAL REGARD TO THE RESULTS*

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Fracture of the neck of the femur is a subject of very great importance, because of the great deformity and disability which it may cause and also because of the prominence of cases of this injury in the Law Courts. I think that I have never attended a council meeting of the Medical Defence Union without hearing a case of fractured neck of the femur discussed, the doctor usually accused of negligence either in diagnosis or treatment.

Not only is the medical profession as a whole under a misapprehension about many aspects of this subject, but both hospital surgeons and current surgical textbooks are often inaccurate in the statement of facts and correspondingly unsound in advice about treatment.

There are three common errors of practice or teaching which it is our duty to combat both by example and precept. The first is the treatment of hip injuries by expectant methods without making an exact diagnosis by the x-ray; and akin to this is the too ready interpretation of a single x-ray picture, as indicating an impacted fracture which requires no special treatment. The second great error is that of considering that an old patient with a fractured femoral neck is unsuited for any active treatment. The third is the idea that non-union of the fracture is the result of old age and that a young adult will therefore recover when treated by simple traction. Of course the truth is that transcervical fractures are quite common in young patients and that such fractures will never unite unless special methods are used to secure firm apposition of the fragments.

*Presented at the Joint Meeting of the American and British Orthopaedic Associations, London, July 4, 1929.

The following propositions will, I think, receive such general assent among all those with interest and experience in this subject that no further time need be spent in discussing them.

1. The diagnosis of all cases of hip injury requires a careful x-ray examination. It is extremely difficult to be certain of the existence or degree of impaction. It is a grave and unjustifiable risk to allow early movement or weight-bearing in a case where impaction is suspected.

2. Every patient with a fractured femoral neck should receive treatment adequate to secure the best chance of union in correct position. There is no need to institute this treatment for a week or ten days after the accident, and this period gives ample time for recovery from shock. The fixation of the hip in a patient of seventy or eighty years never can, never did, and never will cause death from "hypostatic pneumonia".

3. Fractures of the transcervical or intracapsular variety are of quite common occurrence in young or middle-aged patients. Such fractures will never unite unless natural or artificially induced impaction of the fragments is brought about.

4. Fractures of the basal or extracapsular variety are liable to impaction, accompanied by comminution and great distortion. Such a condition urgently demands disimpaction at the earliest possible moment. These fractures have a great tendency to malunion, but they always unite quickly and strongly.

There remain other points for consideration and discussion, about which opinions differ very widely and further information is required before dogmatism is justified. These may be summarized as follows:

A. In regard to primary treatment of recent cases.

1. What are the average results to be expected from efficient treatment?
2. Which method of treatment gives the better results—the Whitman, or direct pegging?
3. Must it be necessary to choose one of these methods to the exclusion of the other?
4. The Whitman method fails in a certain proportion of cases. At what period can the probability of failure be recognized, and direct pegging adopted?

B. In regard to secondary treatment of ununited fractures.

1. At what period may union of the fracture be brought about by operative methods?
2. What is the relative value of different types of operations—*i.e.*,
   a. Autogenous pegging
   b. Ivory or beef-bone pegging
   c. Proximal or distal pegging.

What are the average results to be expected from efficient treatment?

In trying to answer this and other statistical questions two lists of figures are here given, the first from a series of unselected cases of my own and the other a composite series of cases representing two Bristol hospitals, one Manchester hospital, and one Liverpool hospital.

PERSONAL CASES

Number of cases	Death	Union	Non-union	Function: Good	Fair	Poor
24	2	20	2	16	4	2

The fatal cases were both of women of over seventy who died a few days after basal fracture, from shock. The bad results were: (*a*) one case in which a secondary sepsis, after pegging, required removal of the head; (*b*) one case of a woman who refused to keep on the plaster and who developed non-union; (*c*) one of a woman who developed osteitis deformans in the femur and pelvis; (*d*) one case of extreme neurasthenia; (*e*) one case of a stiff hip after pegging; (*f*) one case of adduction deformity requiring osteotomy.

COMBINED SERIES OF CASES

Total number 116. Deaths 18 = 15.5 per cent.
Number of cases where occurence of union or non-union is known 61.
Union: 47. Non-union: 14 = 23 per cent.
Number of cases where late functional results were known 90.
Good: + 42. Fair: + 22. Poor or Bad: + 26

From these combined figures, two rather depressing facts emerge quite clearly: the first, that nearly one-quarter (23 per cent.) fail to obtain bony union; and second, that rather more than half (53.3 per cent.) present results which can only be described as "fair", "poor", or "bad". When it is considered that these figures are derived from the clinics of men taking very special interest in the subject, it may be fairly inferred that the average results in hospital practice all over the country are considerably worse.

Which method of primary treatment gives the best results?

In considering this problem I am afraid I must admit that we have not sufficiently detailed facts relating to any large number of cases; but, nevertheless, certain general conclusions can be made. In the first place, it is quite certain that the true intracapsular, transcervical, or subcapital fracture, must be considered quite separately from the extracapsular or basal. In the latter category, open operation is never considered: first, because comminution makes effective direct suture very difficult; and second, because this type of fracture shows no tendency to non-union. The basal fracture can be effectively treated either by Whitman's plaster or by skeletal traction, always provided that disimpaction of the fracture be carried out as a preliminary.

I cannot prove which of these methods gives the better result, because I have not enough cases for comparison. I should be inclined to give preference to the traction method, because it allows movements at the hip joints at a much earlier period than if plaster-of-Paris is used, and therefore, there will be a much quicker restoration of function.

In regard to the true intracapsular or transcervical fractures, there are only two methods worth consideration for comparison—*viz.*, the Whitman

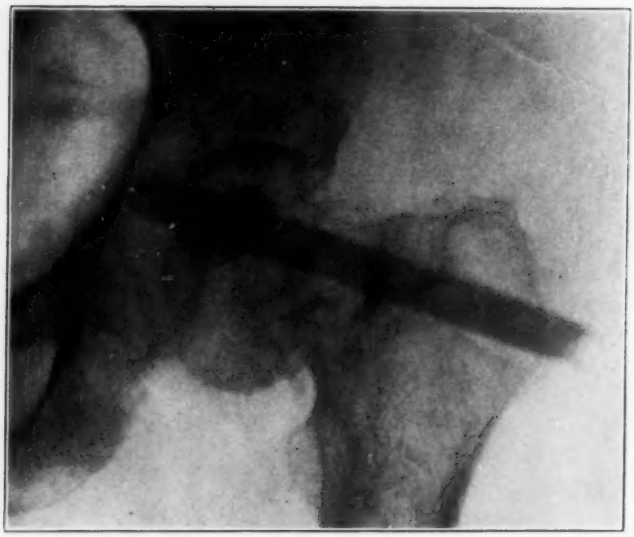

FIG. 1-A
Peg driven too far.

plaster and the pegging operation. There have been a fair number (about 15 out of 59 cases) in which traction in some form has been the method of treatment; but in only one of these did bony union occur, whilst all the rest gave the definitely bad results always associated with non-union. I feel quite justified, therefore, in saying that traction methods cannot be considered as effective treatment for transcervical fractures.

We are left then with the Whitman and the pegging methods, and unfortunately it must be admitted that we have not enough data—in this country at any rate—to institute a comparison. In my own hands both these methods have given exactly the same percentage of successful results, —*viz.*, seventy-five per cent,—but my figures are much too small to justify

FIG. 1-B
Peg not driven far enough.

FIG. 1-C
Peg inserted blindly. Has missed neck of femur altogether.

any general conclusion. Thus in the personal series of unselected cases I have had

Whitman's method: twelve cases with nine good results.

Pegging method: eight cases with six good results.

Is it necessary to choose one of these methods to the exclusion of the other?

Even in dealing with the primary treatment of recent cases, my own personal feeling is strongly in favor of using the open pegging operation in certain selected cases. Basal fractures involving the trochanter, and especially those with comminution, do not come into consideration; for these no open operation is suitable and the Whitman method or that by skeletal traction is satisfactory, provided that full disimpaction can be produced before the limb is fixed.

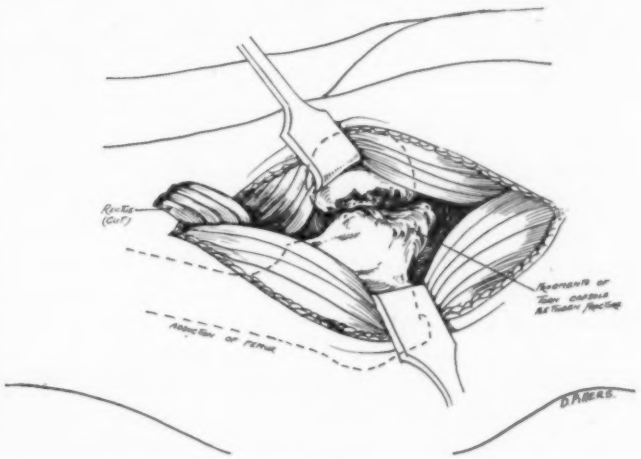

FIG. 2

Exposure of a fracture of the neck of the femur. The reflection of the torn capsule between the fractured surfaces is well seen.

There remains for consideration the transcervical fractures. In these, when the patient is young and active, I choose the pegging operation, reserving the plaster abduction method for elderly, weakly people or those whose mental and physical condition does not promise a rapid return to full function.

The Whitman method fails in a certain proportion of cases. At what period can the probability of failure be recognized and direct pegging adopted?

If the Whitman method is adopted as the routine method of treatment, it is surely not necessary that this choice should be final. In those cases which are doing well, the occurrence of bony union should be recognized at the end of three months, both by clinical signs and by x-ray evidence. If, however, bony union is not taking place, then I would urge very strongly that, in suitable cases, there should be no hesitation in submitting the patient to the open pegging operation. I feel confident that it will be along these lines that improvement in results may be expected.

ON THE SECONDARY TREATMENT OF UNUNITED FRACTURES

It is quite certain that for a considerable period after the injury, and after non-union is definitely established, real bony union may be brought about by an open operation and the use of a peg. It is equally certain that

in some cases no operative fixation will produce union. Therefore it becomes of very great importance to examine the question:—

At what period after the injury and under what other circumstances may union be brought about by operative methods?

My own personal cases are much too few to draw any far-reaching conclusions, but they represent the only data from which I can speak with assurance. They are six consecutive cases which occurred in the same years from which the other personal cases of primary treatment are derived.

Sex	*Age in years*	*Period since injury in months*	*Operation*	*Results*
M.	19	12	Pegging	Good union
F.	44	23	"	" "
F.	56	7	"	" "
M.	60	12	Removal of head	Good function
F.	68	4	Pegging	Good union
M.	72	6	"	Non-union

As these few figures stand they show that good bony union can be obtained in four out of five cases, even though the age is as much as sixty-eight or the period since fracture as much as twenty-three months. But it is a mistake to apply the pegging operation to all ununited fractures of the neck of the femur, because by a careful selection of cases a fairly accurate calculation can be made of those cases in which union is not likely to occur and in which, therefore, it is much wiser to remove the head of the

FIG. 3-A

Fracture of the neck of the femur before operation. A working man of forty.

FIG. 3-B

Same case after distal pegging. The man was able to return to his work as a printer's foreman four months after the accident.

(Figures 1-A, 1-B, 1-C, 2, 3-A, and 3-B are reproduced by kind permission, from the *British Journal of Surgery*.)

bone and do a reconstruction of the joint. In the case of really feeble, old patients the question of operative treatment will not arise. Such patients will remain bedridden, or will be fitted with a walking splint. In regard to those of vigorous habits of life, advanced age need not be a bar to the pegging operation, provided the conditions found at operation are favorable; but when the conditions are doubtful, it is much better to remove the femoral head. A long period of non-union need be no contraindication to a conservative pegging operation. Actually the best result I have ever had was that of a woman of forty-four, whose fracture had occurred twenty-three months before the operation. Perfect union and perfect function followed an operation by which the head was nailed on to the trochanter by a beef-bone peg. To some extent it is possible by x-ray examination to determine beforehand whether the head of the femur is worth saving or whether bony union is possible. Particularly it is possible by radiography to say whether the bony structure of the neck of the femur remains or whether it has been absorbed.

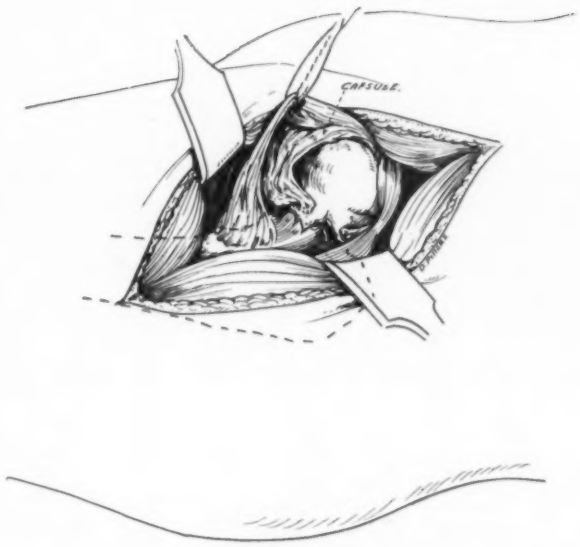

FIG. 4

Fracture of the neck of the femur exposed at operation eighteen months after accident. The deep fibers of the capsule can be clearly seen still attached to the head.

But in many cases the final deciding word can only be spoken after the structures of the head, neck, and capsule have been adequately exposed by operation. Conditions which show that conservation of the head is desirable are as follows: the head and attached part of the neck are firm and hard with the articular cartilage well preserved; the two portions of the neck are so far intact that the broken bone can be fitted together accurately; the reflected fibers of the capsule which take blood supply to the head are preserved in firm attachment to the proximal fragment. On the other hand, conditions which show that preservation of the head is useless are: the head and neck are soft and friable; the articular cartilage is absorbed; there remains no neck to be fitted together; and the proximal portion of the head has no soft attachments, other than the ligamentum teres.

Even with all these data for our guidance there still remains a doubt in some cases as to the advisability of attempting a conservative operation;

but there can be no doubt that if such an operation is successful, it gives a very much better functional result than the reconstruction of the hip.

RELATIVE VALUE OF DIFFERENT CONSERVATIVE OPERATIONS

In the case of recent fractures when there is not much displacement and no question of removing the head, the usual type of operation, in which the peg is driven in from the trochanter after the fracture has been exposed and its surfaces cleared, should be done. It is to my mind essential that the fracture should be exposed, rather than that the peg should be driven in blindly or even under the influence of the x-rays. Blind pegging very frequently leads to very faulty fixation—the peg may go in too far, it may not reach the head at all, or it may miss the head altogether (Figs. 1-A, 1-B, 1-C).

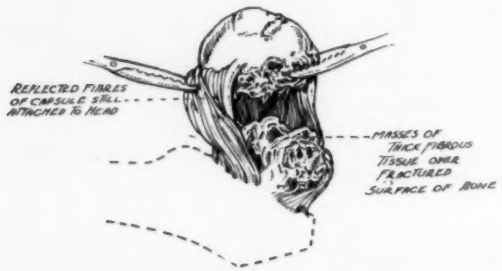

FIG. 5-A

Head has been dislocated; shows reflected fibers of capsule.

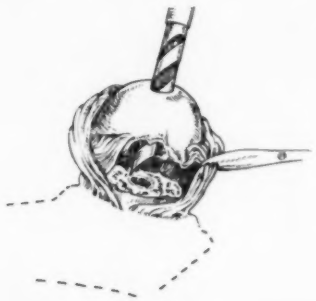

FIG. 5-B

Same case. Head is drilled to receive proximal peg.

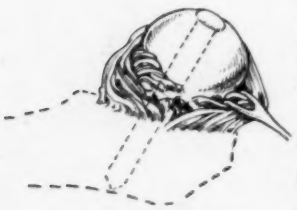

FIG. 5-C

Same case. Peg in position.

Moreover, the whole essence of the open operation is to secure removal of the soft parts which lie between the fractured surfaces (Figs. 2, 3-A, and 3-B).

But in the late operations for non-union, it is better to make a more complete exposure of the head of the bone, and to prise it up from the acetabulum. Only in this way can be determined the characters of the bone, cartilage, and blood supply of the head of the femur. Having dislocated the head, it can then be fitted with accuracy to the shaft and there fixed in position by a bone nail three and one-half inches long and three-eighths of an inch thick (Figs. 4, 5-A, 5-B, 5-C, 6-A and 6-B).

As to the question of the nature of the peg used, this raises all the unsettled and disputed points about the functions and actions of the bone graft. I can only say here that I am satisfied that the beef bone or ivory peg is greatly superior to that cut from the human tibia, and that quite apart from the advantages of shortening and simplifying the operation.

FIG. 6-A

Woman aged forty-four. Fracture of the neck of the femur two years after accident. Condition immediately before operation.

FIG. 6-B

Same case, three weeks after proximal pegging.

FIG. 6-C

Same case, six months after proximal pegging.

FIG. 6-D

Same case, eighteen months after proximal pegging.

It is more than doubtful whether a living graft ever forms new bone itself; almost certainly new bone is never laid down in the middle of cancellous bone. The most favorable thing that can happen to a living graft buried in the midst of the neck of the femur is that it should become permeated by new blood vessels and rapidly absorbed. This absorption is likely to take place before its function as a skeletal strut has been accomplished, and then disunion of the fracture may take place. The beef bone and ivory peg retain their rigid skeletal function much longer, but they do eventually become absorbed (Figs. 6-C, and 6 D).

My last remark I make with some diffidence, because it relates to the technique of the reconstructive operation, which must be done if the head of the femur is removed. In such cases the upper end of the femur as well as the head and neck have usually undergone a good deal of decalcification and the bone tissue is soft, spongy, and friable. It seems to me, there-

FIG. 7-A

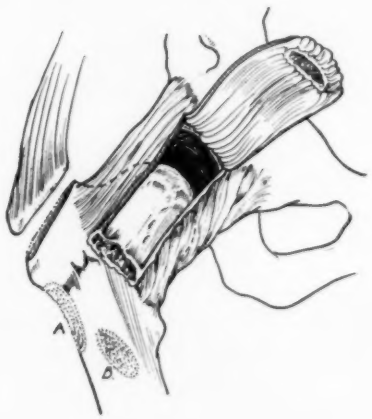

FIG. 7-B

FIG. 7-C

Reconstructive operation for ununited fracture of the neck of the femur.

Fig. 7-A. Fracture exposed. Portion of capsule turned back by chipping off tubercle. Atrophied head of femur is shown.

Fig. 7-B. Head of femur has been removed, greater trochanter excised, neck of femur shaped. *A* and *B* are new positions for greater trochanter and capsule.

Fig. 7-C. Tubercle with attached capsule, and greater trochanter sutured in lower positions. Rounded neck of femur has been placed in acetabulum in abduction. Is maintained in position by taut portion of capsule and greater trochanter.

fore, that if any kind of a weight-bearing end is to be made, there must be as little as possible taken from the great trochanter. One cannot afford to split off from the shaft a massive piece of bone. If the Whitman reconstructive operation is done, removing only the top of the trochanter, then, after the rounded end of the femur has been placed in the acetabulum, there is nothing to keep it from slipping out again, as the capsule will be slack. I would therefore suggest that the strong anterior part of the capsule should be reattached to the shaft of the femur further outwards and downwards. This may be done by chipping off the tubercle on the intertrochanteric line, to which the front of the capsule is attached, and then at the conclusion of the operation, nailing this to the shaft lower down and further out, so that this strong band serves to hold the new head in its place (Figs. 7-A, 7-B, and 7-C).

REMARKS INTRODUCTORY TO A DEMONSTRATION OF THE ABDUCTION TREATMENT OF FRACTURE OF THE NECK OF THE FEMUR*

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My experience in the attempt to establish a standard of treatment for fracture at the hip in accord with that of other fractures, has amply justified the conclusion of Sir Thomas Browne that "the greatest enemy of knowledge is the Goliath of authority and received opinion".

In this instance the received opinion, that this fracture is an exception to all others, is based on the mechanical inadequacy of artificial appliances to maintain contact of the fractured surfaces. For manifestly, since the femoral neck projects laterally from the shaft, splinting and traction can at best appose the fragments only in a lateral and therefore unstable relation.

The exceptional shape of the broken bone is the actual basis of accepted theory and practice. The theory is essentially a defense reaction for therapeutic impotence, the practice a perfunctory ritual, and the results so extraordinarily bad as to be accepted as evidence of the futility of surgical intervention; thus completing the vicious circle, which defines the jurisdiction of the Goliath of authority.

The abduction treatment, by contrast, is in accord with that of other fractures because the natural mechanics of the hip joint are utilized, both to correct deformity and to appose displaced fragments. It has received its distinctive name, because only when the limb is abducted can the fragments be brought into a horizontal plane and therefore end to end.

*Presented at the Joint Meeting of the American and British Orthopaedic Associations, London, July 4, 1929.

When this movement approaches the normal limit, tension on the capsule, which encloses both fragments, must appose and fix them in normal relation. Direct bony contact, the basis of security, is supplemented by complete suppression of muscular action, the most potent factor in displacement.

With an adequate means at command to maintain contact of the fragments, the fortuitous impaction, once the only assurance of stability, has lost its significance; for deformity, even if resistant, may be so easily corrected by natural leverage that it has become merely an incident in treatment which, far from endangering repair, promotes it by apposing the fractured surfaces in normal relation. It only remains to fix the limb in an attitude of full abduction, extension, and slight inward rotation to maintain the essentials of functional repair, as may be verified by roentgen examination at the time of operation and at intervals thereafter.

Under the old conditions, the treatment of the fracture, in view of the danger of enforced dorsal recumbency and its essential futility, was a minor consideration. Now, however, even if the prospect of union of the intracapsular fracture were as remote as it was once thought to be, treatment would be indicated to relieve pain and to protect the patient from infected bed-sores and pulmonary congestion,—complications that have been the chief factors in the high mortality.

The opportunity for repair assured by initial efficiency is supplemented by adequate protection and aftercare, which are of almost equal importance in determining the functional result, and which in the past have been equally neglected.

Thus it will appear that the abduction treatment, simply because it is in accord with that of other fractures, is as radical and revolutionary in theory as in its practical application.

While, therefore, its technical adequacy could be readily demonstrated, it has been extremely difficult to convince the representatives of authority that the old teaching applied only to the old practice, and that efficient treatment of the fracture would not endanger both life and limb.

Recently, however, the abduction treatment, for many years limited to a personal environment, has come into fairly general use, so that results from unprejudiced sources are now available for comparison. In 1928 Katzenstein reported to the Surgical Society of Berlin on 169 cases of transcervical fracture treated by conventional methods. The death rate was nearly eighteen per cent. and the good results eleven and five-tenths per cent. of the number treated.[1] Löfberg, by contrast, in the previous year reported on 176 cases of the same type of fracture treated by the abduction method.[2] The death rate was six per cent. and bony union was attained in sixty-seven and five-tenths per cent.

These statistics have been selected for comparison because they contrast the results of treatment under like conditions of the type of fracture which has set the standard of conventional practice, a standard clearly presented in the following quotation from a modern treatise on fractures,—*viz.*: "The ideal object of treatment, restoration of form and function, is

rarely to be attempted or even sought. The first indication is to save life; the second to get union; the third to correct or diminish displacements."

These indications represent the old appraisement of clinical values from the negative standpoint; but now that an effective treatment is at command, the order has been transposed. The most important patient is no longer the oldest, as when the saving of life was "the first indication", but the youngest, because he must suffer most from the inefficient treatment. The most important fracture is no longer the subcapital, because it has the least capacity for repair; but that at the base of the neck, because the functional result is most directly determined by the quality of the treatment.

In other words, the first consideration is no longer to justify present neglect by past failure, but to justify efficiency by the reasonable assurance of success.

This from a relative standpoint is a simple proposition, for it has now been amply demonstrated: that the strict application of surgical principles is practicable in the great majority of cases; that the danger of treatment, once the chief excuse for neglect of the fracture, is almost negligible; that union of the transcervical fracture, once considered a remote possibility, may be attained in the larger proportion of the cases.

Finally, since all cases are treated by the same method and with the same purpose, the fracture may be considered as a therapeutic entity, and if the functional results be estimated from this standpoint, they will compare favorably with those of any other fracture involving a joint of the lower extremity in patients of the same class.

A new treatment must be tested by novices, and although the results attained in inexperienced hands furnish the strongest evidence of its practicability and effectiveness, this factor may best explain the variations in the method that have been introduced, and particularly the attempts to apply the principles of the abduction treatment by traction or other conventional appliances. These substitutes have the technical disadvantage of requiring constant supervision to assure even relative security, and the physical disadvantage of subjecting the patient to the discomforts and dangers of dorsal recumbency.

The long plaster spica, which, as the most technical part of the procedure, has received the most adverse criticism, may be considered an integral part of the abduction treatment, because it is the only support generally available and fortunately, when properly applied, the most comfortable and the most efficient. It has the outstanding merit of permitting the alternation of posture, which is the distinguishing characteristic of the abduction treatment, and which has extended its range of practicability to the infirm and aged class.

In this connection it may be suggested that since the spica is a secure and independent support, the patient, after its application, might be transported, as is so often necessary, to other institutions, thus providing an opportunity for demonstration of the method to students.

This is an important consideration, for hospitals as a class are upholders of conservatism in so far as it is exemplified by virtual neglect,—ostensibly for lack of accommodation, actually because it is not at present conceded that this fracture is entitled to the privileges that efficient treatment demands.

It seems fair to conclude that the peripheral pressure of comparative statistics must eventually force an official admission that fracture of the neck of the femur is now amenable to the rules that govern the treatment of other fractures. In this event, the most neglected of all fractures will become of the first importance, since the greater the obstacles to repair, the more directly is success dependent on favorable opportunity, and therefore on the technical efficiency of the treatment, and on the skill and experience of the one who conducts it.

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LESIONS OF THE GREATER TROCHANTER

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The conclusion might well be reached, by one considering casually the greater trochanter of the femur, that this area of bone is not subject to frequent or a wide variety of diseases. That such a conclusion would be incorrect has been brought to the attention of the authors by a number of interesting roentgenograms which have come to their attention during the past few years. It has seemed to them that a selected series of these films might be of interest and value in directing attention to the wide variety of lesions which occur in this region.

In this series an attempt has been made to show only one case of each type of disease. This attempt may not have been wholly successful, since the impossibility in a number of these cases of establishing a positive diagnosis may have resulted in a few duplications.

A list of the cases, brief clinical histories, and the roentgenograms are hereby submitted.

LIST OF CASES

1. Pretrochanteric bursitis (Probable diagnosis).
2. Pretrochanteric bursitis with osteitis of underlying greater trochanter (Probable diagnosis).
3. Staphylococcus aureus osteitis of greater trochanter (Diagnosis established).
4. Typhoid osteitis of greater trochanter (Probable diagnosis).
5. Tuberculosis of greater trochanter and pretrochanteric bursa (Diagnosis established).
6. Brodie's abscess or cyst of greater trochanter (Probable diagnosis).
7. Chondroma of greater trochanter (Diagnosis established).
8. Osteitis fibrosa cystica or giant-cell tumor of greater trochanter (Probable diagnosis).
9. Giant-cell tumor or plasma-cell myeloma of greater trochanter (Probable diagnosis).
10. Endothelial myeloma of greater trochanter (Probable diagnosis).
11. Osteogenic sarcoma or endothelial myeloma of greater trochanter (Probable diagnosis).

FIG. 1

Case 1. Acute pretrochanteric bursitis. Quite dense shadow in region of bursa.

FIG. 2

Same as Fig. 1, one month later. Shadow of bursa has disappeared.

CASE HISTORIES

CASE 1. Woman in the early sixties taken suddenly, while walking, with extreme pain in the hip. She was carried to the hospital, where, because of the severity of her symptoms, a tentative diagnosis of fracture of the femoral neck was made. X-ray showed only a shadow of the density of calcium in the soft tissues just lateral to the greater trochanter (Fig. 1). A diagnosis of acute bursitis was made. She was treated with physiotherapy. Well symptomatically in one week. X-ray taken one month after onset showed no abnormal shadow in the region of the bursa (Fig. 2).

CASE 2. Man, aged forty, with complaint of pain in the region of left hip. Physical examination negative except for pain on rotation of the hip. An x-ray showed bone destruction in the lateral portion of the greater trochanter with small calcifications in the overlying soft tissues (Fig. 3). A probable diagnosis of bursitis with secondary osteitis of the underlying trochanter was made. This opinion receives support from the similarity of the x-ray appearance in this case to that of a previous case, of which the films are not available, in which the diagnosis was established by operative findings. Patient received some palliative physiotherapy, to be followed by operation if symptoms were not relieved, but he soon disappeared from the clinic.

FIG. 3

Case 2. Clinical diagnosis, pretrochanteric bursitis with secondary osteitis of underlying greater trochanter. Bone destruction with small calcifications in overlying soft tissues.

CASE 3. Boy, aged eight. Complaint of pain and swelling of the thigh, duration uncertain. Physical examination showed a greatly swollen thigh suggestive of neoplasm. X-ray showed a small area of bone destruction in the greater trochanter (Fig. 4). At operation a small area of osteitis of the greater trochanter was found, with an enormous abscess extending down into the thigh, lying between the muscles and the bone (Fig. 5). Culture, staphylococcus aureus. Pathological report, acute and chronic osteitis. Course typical of osteomyelitis, with development of another focus in the shaft of the radius about a year later.

CASE 4. Child, aged three. Treated in another hospital for typhoid fever. Chronology is uncertain, but during the typhoid fever she developed pain in the left hip. She was placed in plaster spica. Because of the child's constant crying, mother brought her to the Hospital for Ruptured and Crippled, where she was admitted two months after first admission to the other hospital. X-ray showed a large abscess cavity in the right greater trochanter, with numerous shadows suggesting sequestra lying in it, and with much periosteal thickening. There was upward dislocation of the hip, with a natural shelf of bone being laid down above the displaced femoral head (Fig. 6). Unfortunately no culture was taken at operation or subsequently, so the clinical diagnosis of typhoid osteitis was not proven. Wound healed in about one month (which is evidence against an ordinary pyogenic osteomyelitis). Since that time the child has been under treatment for her dislocation.

CASE 5. Woman, aged thirty-eight. Five years' history of intermittent ache in left thigh, much worse during past few months, preventing sleep. X-ray showed a small area of bone destruction in the lateral portion of the greater trochanter, with no evidence of proliferation or repair processes (Fig. 7). Operation showed an enlarged and thickened bursa overlying the trochanter, with softening of the bone beneath this for a depth of three-eighths of an inch. Diseased soft tissue and bone were removed. Pathological report, tuberculosis of bone and soft tissue. Wound healed promptly. No follow-up report to date.

FIG. 4

Case 3. Staphylococcus aureus osteitis of greater trochanter with huge abscess beneath thigh muscles. Small area of bone destruction shown in greater trochanter.

FIG. 5

Same as Fig. 4, three weeks later, after operation.

FIG. 6

Case 4. Case of probable typhoid osteitis of greater trochanter.

FIG. 7

Case 5. Proven case of tuberculosis of greater trochanter and overlying bursa. Small area of bone destruction, without any evidence of reparative processes.

FIG. 8

Case 6. Provisional diagnosis, Brodie's abscess or cyst of greater trochanter.

FIG. 9

Case 7. Degenerating chondroma of greater trochanter.

FIG. 10

Case 8. Probable diagnosis, osteitis fibrosa cystica or giant-cell tumor of greater trochanter.

FIG. 11

Case 9. Pathological diagnosis from another hospital, plasma-cell myeloma. Clinical diagnosis at Memorial Hospital, because of x-ray appearance and clinical course, giant-cell tumor.

FIG. 12

Case 10. Case of probable endothelial myeloma.

FIG. 13

Case 11. Osteogenic sarcoma or endothelial myeloma of greater trochanter.

CASE 6. Man, aged forty-six. Complaint of pain in the region of the greater trochanter when at work operating a press machine with foot. Examination showed slight tenderness over the trochanter. Stereoscopic films showed a large rounded, thick-walled cystic area in the greater trochanter (Fig. 8). A clinical diagnosis of Brodie's abscess or cyst was made, but the patient declined operation and disappeared, and the diagnosis was not established.

CASE 7. Man, aged twenty-eight. Complaint of pain, tenderness of left hip, and limp on left side, of six months' duration. X-ray examination showed a large multilocular cystic area in the greater trochanter and adjacent portion of the neck (Fig. 9). Clinical and x-ray diagnosis of giant-cell tumor made. X-ray therapy instituted. Because of continued pain and slow increase in size of the tumor, operation was advised, and the involved area of bone curetted out. Pathological report, degenerating chondroma. Course: patient weakened gradually from pain and low-grade infection, and died eight months later, with no clinical or x-ray evidence of metastasis.

CASE 8. Woman, aged fifty-seven. While standing, developed a sudden pathological fracture of the left femoral neck. X-rays showed a multilocular cystic condition involving the entire greater trochanter and the adjacent portion of the femoral neck (Fig. 10). Clinical and x-ray diagnosis of either osteitis fibrosa cystica or giant-cell tumor. Treated by radiation over a period of six years, without any apparent progress of the disease.

CASE 9. Woman, aged fifty. Fell and fractured right hip about two and one-half years before admission. Hip seemed to heal well, but a tumor developed in greater trochanter. Four weeks before admission was operated upon at another hospital, and pathological report from that hospital was plasma-cell myeloma. X-ray examination, upon admission to Memorial Hospital, showed the entire greater trochanter and the adjacent portion of the femoral neck filled with a multilocular cystic process, with much expansion of the cortex (Fig. 11). A clinical diagnosis of giant-cell tumor was made. Patient received radiation treatment; was in good condition two and one-half years later.

CASE 10. Man, aged twenty-eight. Complaint of pain in right foot for two years, in right thigh for one and one-half years, swelling of right thigh for nine months. Examination showed a large soft-tissue tumor. X-ray examination showed a mottled and moth-eaten appearance throughout the greater trochanter, upper portion of the femoral shaft, and the femoral head and neck. No expansion of the cortex. There were areas of destruction, but no evidence of any repair or bone production. There was a pathological fracture in the upper third of the femoral shaft (Fig. 12). Though the appearance suggested carcinoma metastasis, no primary focus was found, and a large soft-tissue tumor was present. Clinical diagnosis, endothelial myeloma. Course: no response to intravenous lead treatment. The tumor shrank considerably under radium-pack treatment (further evidence in favor of endothelial myeloma and against carcinoma metastasis). Patient developed metastases of spine and ribs, and died eleven months after first admission.

CASE 11. Boy, aged ten. Had a limp on left side for five days, followed by a fall in a schoolboy tumble. This caused a pathological fracture of femoral neck. Was treated for nine weeks by local physician with casts for tuberculosis. Was then referred to Memorial Hospital. X-ray examination showed a destructive process involving the greater trochanter and head and neck, without expansion of cortex, and without any evidence of repair or new bone formation. The line of the pathological fracture of the neck was shown (Fig. 13). Clinical diagnosis: central osteogenic sarcoma, or endothelial myeloma. Was treated by radiation and Coley's toxins. General condition seemed to improve but not the local condition. This lack of local improvement favored the diagnosis of sarcoma. Patient left town. Through follow-up letters it was learned that one year later he developed a suspicious spot in a lung. For several months following this he had severe pain in the lower back. Died sixteen months after his admission to Memorial Hospital, presumably from metastases.

MANIPULATION OF JOINTS

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The object of this paper is to present the subject of manipulative methods in the treatment of selected cases of stiff and painful joints. While the subject has been most ably presented by Timbrell Fisher in his monograph "Manipulative Surgery", published in 1926, and in various writings of Sir Robert Jones, this important subject is not accorded due recognition. While conscious of the fact that surgeons particularly interested in the diseases of bones and joints are familiar with the fundamental facts outlined in this paper, I believe that the value, as well as the dangers, of forcible manipulation is frequently overlooked. If this is true among those of us who profess a more than ordinary knowledge of joints, it must be more generally so among the profession as a whole. Joint manipulation has been largely in the hands of the various cults or irregular practitioners. The medical profession should have an open mind on this subject, and grant that treatment at the hands of unqualified practitioners is often reported to bring about relief where treatment by physicians has failed. While the manipulator does no particular harm in the great majority of cases, disastrous results follow the manipulation of acutely inflamed joints, tuberculous joints, and fractured vertebrae. However, the more experienced bonesetter of today has learned to respect the tuberculous joint, and consults with a competent radiologist for diagnosis. If there were not something of good in this it would not continue to exist, and it behooves the medical profession to cull the true from the false in these so called cults. It is only by a better understanding of manipulative methods that we can protect the public from the dangerous element in these cults, and direct a more intelligent treatment in certain joints where recovery is unduly delayed.

This paper discusses the diagnosis and pathological changes which, in the more obscure cases, cause limited and painful motion in a joint, and attempts to give indications for moving a joint or putting it at rest. This includes a discussion of the cases that bonesetters are said to cure, and how their results are obtained. It is intended to be a plea for a more serious study of these more obscure cases, and to give recognition to the value of manipulations in carefully selected cases. What there may be in so called bonesetting should be put on a scientific foundation, based on a knowledge of anatomy, physiology, and pathology. This discussion is confined to the presentation of basic and general principles, leaving the details of treatment to a later paper.

Timbrell Fisher[1] calls the attention of the medical profession to the importance of manipulative surgery in the treatment of the sequelae of injuries and diseases affecting the joints, muscles, tendons, and fascia.

Fisher, Bristow and Elmslie[3] forcibly express the opinion that the principles and practice of manipulative treatment should be brought more prominently before the student in our medical schools. The writer is convinced that the medical profession has neglected this particular branch of work to the detriment of the patient, and that too little attention is given to patients with the comparatively minor complaints not on the surface indicative of an organic lesion. There is a tendency to minimize their complaints and pass them off as neurotics. Naturally, if physicians are not interested, they patronize the unqualified practitioners. It is by no means only the ignorant who patronize the various cults. On the other hand, it is a fact that the clientele of the better known bonesetters, etc., are people of apparently high-grade intelligence. The attitude of the medical profession as a whole is that of skepticism and derision, as so many of the workers in this field have little or no knowledge of anatomy or pathology. Granted that certain of these patients have minor ailments and their complaints come under the head of hysterical joints; yet, if free movement can be obtained by manipulation under anaesthesia, either by suggestion or by the freeing of adhesions, the treatment is beneficial, and is worthy of more attention than it at present receives.

While admitting our own limitations as to a knowledge of the exact pathological changes present in obscure lesions about the joints, muscles, tendons, and fascia, and particularly about the spine; nevertheless pathological changes in and about the shoulder, elbow, wrist, knee, ankle, and tarsal joints are fairly well understood. With succeeding years we are learning more about the back with its complexity of joints, ligaments, muscles, and fascia layers.

There are cases of back pain, so called sciatica, lumbago, stiff and wry neck, etc., in which the pathology is not well understood, most likely because of the absence of thorough postmortem examinations. These patients do not die because of these complaints, and therefore we have no opportunity for a correlated study of the subjective symptoms and physical findings with the changes found at autopsy. It is difficult to obtain the consent of the patient to do an exploratory operation on his back unless we can reasonably assure him that he will be relieved.

Manipulation of joints undoubtedly was practised from the earliest times by the physician. It is likely that as pathological changes became better understood, the importance of rest for the acutely inflamed joint was realized, and it was not long before rest was considered essential for all painful joints. The treatment of the comparatively unimportant painful joint was lost sight of in the rapid advances in the diagnosis and treatment of more acute and disabling conditions. More interesting fields were opened to the surgeon by the discovery of anaesthetics, and by the work of Pasteur and Lister. As a result the comparatively uninteresting complaints of the chronic patient were put aside, and there arose the unqualified practitioner who thrived on those cases neglected by the medical profession. The group, known as bonesetters, usually recruited

from the less well educated classes, arose throughout Europe, and became especially prominent in England where the knowledge was considered a trade secret, and handed down from father to son for generations. During the latter part of the nineteenth century the Taylors, the Huttons, the Masons, and the Matthews attracted wide attention, prompting well known surgeons to inquire into their methods, and to publish the results of their investigations in the *Lancet* and *British Medical Journal*. These men, among whom were Sir James Paget, Wharton Hood, Dacre Fox, and Howard Marsh, began to question the wisdom of the fixed rule of rest to all painful joints. However, the efforts of these men were not sufficient to overcome the doctrine of rest preached by the great teachers,—among whom were John Hunter, Hugh Owen Thomas, and John Hilton. Today osteopathy, chiropractic, and a host of other cults, continue to thrive chiefly because of a continuation of this doctrine of prolonged rest, and a failure of the physician to apply his knowledge concerning the formation and treatment of adhesions. However, we are breaking away from this teaching. For example, we no longer treat sprained ankles by rest, but encourage motion and weight-bearing from the beginning with protection of the torn ligaments. The lessons learned during the late World War taught us the value of early motion to injured and infected joints. Although physiotherapy existed before the War, its application was largely in the hands of untrained individuals. The demand in this particular field for a well trained personnel is now being supplied by large orthopaedic and government hospitals where excellent training may be had. It is unquestionably true that great good is derived by intelligently directed physiotherapy; but, on the other hand, as a result of that popularity, we are in danger of overdoing it, and a reaction may set in. Apparatus for light treatments, diathermy, and various other electrical machines are becoming articles of equipment in almost every doctor's office, and their promiscuous use is apt to bring discredit upon valuable methods. With our present-day advantages of well trained physiotherapists, there is a tendency to expect too much from them. We are apt to rely too much on prolonged baking and massage to limber joints, although it is quite possible that the desired result may eventually be obtained.

To return to the doctrine of rest, it became the teaching to regard pain as a symptom indicating rest, and that motion could always be restored by subsequent use after the subsidence of the acute inflammation or the healing of the fracture. Hugh Owen Thomas stated in a letter to Sir James Paget, "I cannot find suitable cases upon which I would perform the deception known as passive motion"[2]. Sir James Paget[4], in a lecture, "Cases that Bonesetters Cure", was apparently the first of the leading physicians to recognize the value of motion in selected cases. He concluded his lecture by a statement that holds good today as then, "Learn to imitate what is good and avoid what is bad in the practice of bonesetters". He advises against too long rest; that cold joints should be moved, and that the temperature of the joint should be the guide.

Before the year 1871, when Wharton Hood[5] published a series of papers in the *Lancet*, there was no attempt to consider the subject seriously. These papers were published as a result of his study to ascertain what good, if any, was accomplished by bonesetters. A famous bonesetter of the day, a Mr. Hutton, had been attracting wide attention and publicity. He became indebted to Wharton Hood's father who treated him during a long and severe illness. As an acknowledgment of his gratitude he taught Wharton Hood his methods as a bonesetter. For the first time the meaning of these mysterious movements was made clear to the medical profession. Hood gives a good classification of stiff and painful joints, incidentally recognizing a chronic subdeltoid bursitis, and describes the types of cases benefited by Hutton's manipulations. In detail he describes Hutton's procedures for each joint, accompanying his descriptions with drawings. Muscle resistance was minimized by holding the joint in rotation during the forced manipulation. Hutton had no knowledge of anatomy or pathology and boasted of the fact, and believed that in every case a bone was out. When he ruptured a ganglion or broke an adhesion he was misled by the disappearance of the ganglion or the sound of the rupturing adhesion, and believed that he had reduced a dislocation.

Dr. Bruce Clark[9] was among the first to describe, from the dissection of amputated limbs, the real nature of adhesions which caused disability capable of being cured by free movements. Dr. R. Dacre Fox[6] writing from three years' experience with a Mr. Taylor, bonesetter, published a paper in the *Lancet* in 1882. He believed that joints stiff from prolonged rest were most successfully treated by bonesetters, and that manipulations should be forced and sudden, as a gradual stretching irritates. He gives a classification of stiff joints benefited by bonesetters. Fox aptly states that "nothing has done more to lower the prestige of regular practitioners and to play into the hands of unqualified bonesetters than the way in which so many practitioners tamper with a sprained joint". Dr. Howard Marsh was an advocate of motion in selected cases. He believed that the methods of bonesetters should not be unjustly condemned.

The only work the author has been able to find written by a bonesetter is "The Art of the Bonesetter" by G. Matthews Bennett[7] published in 1884. Bennett styles himself as a "specialist for all kinds of dislocated joints, fractures, sprains, etc.". This is a book of some 136 pages mostly given over to testimonials of his patients as to his marvelous cures. He jealously guards the secrets of his methods, intimating that it is a gift which can not be acquired. He gives a poor presentation of fractures and dislocations, and does not mention the spine.

There can be little doubt but that the tricks in the trade of bonesetting in use today are those of former years. It is commonly believed that a dislocation is reduced, or that a tendon is slipped into place. Among those who claim to have an intimate knowledge of anatomy, their skilled fingers readily discover a dislocation of the long head of the biceps as the cause of shoulder disabilities, displaced peronei tendons at the ankle, a

subluxated fibrocartilage at the inferior radio-ulnar articulation, displaced tendons in the foot causing metatarsalgia, etc. Dislocated or subluxated sacro-iliac joints yield to a thrust on the sacrum, after first encircling the arm about the pelvis to open up the sacro-iliac joints by compression of the iliac crests. Wharton Hood describes in detail the methods used, and with Fox, Romer[8], and Fisher describes the location of the most important tender or painful spots.

To understand the type of case that is benefited by the bonesetter, or —what is more important— the type of case in which manipulative surgery may be indicated, let us review the pathological changes about joints following an injury. When we undertake to discuss the diseases and injuries of joints we can not confine our attention solely to the structures within the synovial cavity. All the structures which have to do with producing motion must be considered as a part of the joint: ligaments, muscles, tendons, bursae, fascia layers, and even nerves as well. If there is a disease within the joint, all these other structures are secondarily involved. An infection or injury of the synovial membrane or joint cartilage is accompanied by more or less damage to ligaments and capsule, muscle atrophy and muscle spasm, with contracture or shortening of muscles, ligaments, or tendons. Even early atrophy and diminution in the number of the anterior horn cells of the spinal cord has been demonstrated[10]. Relaxed ligaments, poor muscular development, and hypotonia of the muscles make the joint more susceptible to static strain or injury with resulting hyperaemia and thickening of the synovial membrane, as in villous arthritis. Disease of the central nervous system may result in arthropathies, and recently Leriche[11] has advocated an interesting and thoughtful theory as to the cause of traumatic arthritis. He believes that through a disturbance of the sympathetic system the usually temporary local hyperaemia causes an absorption of lime salts from the bones. Thus the condition of osteoporosis is produced with its manifestations of pain, tenderness, and limitation of motion.

Our conception of a joint, then, can not be so narrow as to be only that of the articulation itself, but must be considered physiologically as a whole with no one component part being diseased without having an effect on the whole mechanism. Some joints are more stable than others and less likely to be the seat of subluxations or static strains. Some are simple in structure and superficial, and therefore the causes of disability are easily diagnosed; some, as the spine, are extremely complex and deep seated, and therefore accurate diagnoses are difficult. However, it will help to clear the haze if we consider that regardless of the location of the joint, in its broader conception the reactions and sequelae to injury are the same.

We need not discuss those joints which are the seat of an active inflammation with local heat and muscle spasm. These joints require rest, and should not be moved. We are all aware of the danger of the formation of adhesions in the severely traumatized joint, and begin motion early. It is the less severely injured joint, either as a result of trauma or toxin, that

is of concern here. We may, therefore, briefly discuss some of the less severe injuries about joints.

Strains of Muscle Attachments. A strain is diagnosed by the presence of pain when the muscle is actively contracted against resistance, or when it is passively stretched. Usually there will be found a localized area of tenderness at the insertion of the tendon. According to Sir Robert Jones[12], "This tender spot is the key to the situation. It is a small patch of effusion below the periosteum or in the fibers of the tendon which run in and through the periosteum to the bone. . . . The pain is due to the tension on this effusion caused by tension on the muscle, or by direct pressure on the oedematous spot." Such an injury may be acute, as a result of a single strain, or chronic, as a result of repeated strains before the original condition has healed, thus tearing the newly formed repair tissue and maintaining the effusion or congestion at the site of the torn fibers. Treatment should, therefore, be directed toward a relief of the effusion, and the prevention of further strain by rest. In chronic cases adhesions of fibrous tissue limiting free and painless motion may form between the muscle layers, or within the tendon sheaths or bursae. Treatment, of course, in the latter condition is motion.

Sprains of Ligaments. If there has occurred a sprain or rupture of the fibers of a ligament, the process is similar to that above. In superficial joints where the anatomical location of the local site of tenderness can be accurately localized away from a tendinous insertion, the diagnosis is easy, —*e.g.*, the lateral ligaments of the knee or ankle joint. Among deeper structures, as the spine, this is more difficult. Active contraction of muscles which do not put a tension on the sprained ligament will not cause pain. It makes no practical difference, however, as in this condition also the joint must be protected from motion which puts a tension on the sprained ligament, and there must be a protection from unnecessary strain until it has recovered its full strength. Where possible, as in the recently sprained ankle, other motions should be allowed from the start to prevent the formation of adhesions.

Extensive Rupture or Laceration of Ligaments. In more extensive injuries to ligaments permitting dislocation, it is necessary, of course, for the joint to be put at rest to permit the repair of the torn ligaments. This repair means a considerable formation of fibrous tissue with possibly the formation of strong adhesions. It is important to know the right time for breaking these down. We can determine this if we remember the process of repair. After the dislocation has been reduced, there forms a mass of blood clot and plastic effusion, part of which will become organized with the formation of strands of fibrous tissue or adhesions. If any forcible attempt is made to break these bands while the cicatrix is still fresh and vascular, and therefore tender to pressure, pain, more bleeding, and effusion will follow, forming a more extensive fibrosis and further adhesions. Therefore, in the recent case motion must be gentle, and kept within the degrees of severe reactions.

Traumatic Arthritis. Sir Robert Jones[13] calls our attention to contusion of joint cartilage as a cause of pain. This may not make its appearance until two or three weeks after the injury. It is said to occur typically in the shoulder joint in association with a Colles' fracture. The force of the blow is transmitted upward through the arm to the shoulder. When the patient attempts to use the arm after the splints have been removed, he complains of pain in the shoulder. Active and passive motion of the shoulder is urged, and the shoulder gets worse. What really happened is that at the time of the fall on the outstretched arm the articular cartilage of the shoulder was bruised or crushed. Cartilage is a non-vascular tissue, and no repair can take place until new blood vessels have grown from the periphery to clear away the debris. Thus, there is an area of active inflammation within the joint, and movement causes more pain and inflammation.

Bursitis. A bursa is subject to the same pathological changes as is the synovial membrane. Of particular importance clinically are the subacromial bursa, the bursae about the knee, the bursa at the attachment of the Achilles tendon, that over the great trochanter, and the radio-ulnar bursa at the elbow. Trauma, static strain, infections or toxins, either separately or combined, are responsible for an acute or chronic inflammation. Here again there is an effusion of a plastic exudate which may become organized with the formation of adhesions if the part is kept at rest too long. During the acute stage the indication is rest. Motion too soon will only aggravate the inflammation with the outpouring of more plastic lymph. Pain, as at the shoulder, is sometimes very severe, and is caused by muscle spasm which may be lessened by traction and the application of heat. In the chronic case disability is caused by adhesions. Codman[14] has pointed out the great frequency of injury to the supraspinatus tendon of greater or lesser severity, and we should always be on guard against a rupture of this tendon.

Dislocated or Slipped Tendons. This group is considered briefly because of its relatively infrequent occurrence. It undoubtedly does occur at the shoulder where the tendon of the long head of the biceps is displaced from its groove. This may be diagnosed by the fact that the tendon may be felt, and that active contraction of the biceps, or passive stretching of this tendon, causes pain. Displacement of the peroneal tendon forward over the malleolus is easily felt.

Myositis. The real nature of myositis apparently is not understood generally. The term has fallen into disrepute as it has frequently been used as a diagnosis to cover up a vague condition. It may be the result of infection, toxin, or trauma. There is a fibrositis or hyperplasia of the connective tissue in the muscle, which is seen most commonly in attacks of true lumbago, acute wry or stiff neck. Llewellyn and Jones[15] believe that infection or toxin makes the sense organ located in the tendons hypersensitive. There is therefore an increased muscle tone, and in the acute case, a collapse of the veins which are more compressible than the arteries. The

engorgement of blood into the muscle causes swelling and heat. In the chronic case the circulatory stasis stimulates an overgrowth of fibrous elements. Treatment, therefore, in the acute case is rest, together with heat and massage to relieve this passive congestion and decrease muscle spasm. In the chronic case infiltrations or nodules are usually palpable in the muscles at the tendinous attachments. These can be dispersed by massage only when strictly localized. The treatment in the chronic case is massage to relieve the source of irritation of adhesions about the muscle bundles and tendinous insertions, and passive and active exercises.

Arthritis. The subject of arthritis should probably not enter into this discussion as only rarely in arthritis, do we meet with instances of simple and uncomplicated periarticular adhesions. The inflammation is not limited to the synovial membrane, but the articular surfaces and the ends of the bones are also involved. In the great majority of cases stiffness is due to muscle spasm, sclerosis, and contracture. In such conditions manipulation is contraindicated. Even passive motion is risky. The writer has manipulated a shoulder and knee, however, with gratifying results. In these cases the persisting stiffness was apparently no longer the result of any active or smouldering infectious arthritis. Aitken[16] manipulates hip joints with quiescent osteo-arthritis. He believes that adhesions and not osteophytes limit motion.

Back Pain. The subjects mentioned above are common to all joints including the spine. But here accurate diagnosis and therefore rational treatment are decidedly more difficult. There is great confusion because of the depth of the structures involved, and because of peculiar anatomical relationships. Postural defects, anatomical variations, and the multiplicity of joints complicate the picture and make us proceed with caution. Putti[17] regards many of these cases of painful back as a neuralgia, caused by pathological conditions of the intervertebral foramina, particularly chronic arthritis involving the interarticular articulations. He has resected the posterior articulations with good results. The bonesetter, or whatever we wish to call him, proceeds on the assumption that in all cases there is a misplacement, and on that basis unhesitatingly manipulates where we are more cautious. It is quite likely, though, that in some cases of the "fool rushing in where angels fear to tread", manipulation was the indication.

Adhesions about joints are classified as being intra-articular or extra-articular. They are of various forms varying from comparatively small bands connecting folds of synovial membrane, or other intra-articular structures as in the knee, to thick and dense bands bridging the articular space from one cartilaginous surface to the other. Needless to say, forcible manipulations to break up these dense bands causing fibrous ankylosis are doomed to failure, as there has been a destruction of cartilage, and the severe reaction is followed by a hemorrhage into the joint. If the restricted motion is caused by adhesions, and not a generalized sclerosis and contracture, we may expect free motion following rupture of these bands.

One is greatly assisted in making a diagnosis of adhesions by the characteristic limitation of motion,—*i.e.*, motion is limited and painful only in the direction which stretches the adhesion, and this motion may be free and painless up to a certain point. In making the examination, it is important that the normal range of motion be determined by comparison with the joint on the other side, so that those slight limitations of motion may not be overlooked. These cases in which slight limitation of motion is overlooked are most likely to be benefited by manipulation. Tenderness is present over the site of the attachment of the adhesions, and is commonly present at definite sites according to the individual joint. Bony obstruction, such as myositis ossificans, unreduced fractures, or excessive callus formation near a joint, may block motion. Manipulation here will accomplish nothing, and may do positive harm by the irritation produced.

When a diagnosis of adhesions has been made and, after a reasonable length of time, relief is not obtained by physiotherapeutic measures, manipulation becomes indicated. To rupture all adhesions it is necessary that the joint be put through its complete range of motion. Because of pain and muscle resistance this can be accomplished only under the complete relaxation of a general anaesthetic. Half-hearted attempts will fail to free all bands, and merely stretching them will result in further irritation. Care must be taken to prevent dislocation or fracture, and for this reason short leverage grips are safer. The movement must be gentle and not unnecessarily rough, for we wish to minimize the resulting effusion and irritation. For the same reason the joint should be put through its normal range of motion only once. Repeated movements accomplish no more. A fair idea as to prognosis may be had at the time of manipulation. Motion obtained easily with the unmistakable rupture of adhesions is a favorable sign. The more indefinite elastic resistance, without the feeling of adhesions giving way, is a less favorable indication of a good prognosis.

Since the object of manipulation is to break down adhesions, it is inconsistent to put the joint at rest afterwards. Further than simple apparatus suitable for holding the joint temporarily in the position not possible to be obtained before, fixation is contraindicated. For completely satisfactory results cooperation of the patient is essential, and active motion is insisted on as soon as possible. It is helpful to secure the confidence of the patient if the surgeon, as soon as the patient has recovered from the anaesthetic, demonstrates the free motion by putting the joint through its range of motion. The critical period is during the first forty-eight hours. If reaction and pain are severe, heat, massage, and, in suitable cases, traction are indicated to relieve muscle spasm.

SUMMARY

Forcible manipulations accomplish relief from joint pain and stiffness by the rupture of adhesions, or by the reduction of a displaced fibrocartilage in internal derangement of joints, as in the knee, wrist, or jaw. This

important form of therapy is being neglected by members of the medical profession who should become familiar with the methods of manipulation. Unintelligently applied force is inherently a dangerous means, and the use of extreme force is always to be condemned. The public, and many physicians as well, has been led to believe that treatment by manipulation is not included in the resources of the qualified physician or surgeon. There is nothing mysterious in the art of the bonesetter, and the rationale of so called bonesetting in the indicated case is readily understood when we review our knowledge of the anatomy and pathology of joints. By careful observation of our patients and the recording of our results we can put this procedure on a rational basis.

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SURGICAL PATHOLOGY OF SYNOVIAL TISSUE*

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The increasing popularity of synovectomy and other operations on joints suggested a further study of the histopathology of synovial tissues. Descriptions of the gross appearance of diseased joints are generally known, and are referred to, frequently, in textbooks dealing with the subject. However, microscopic observations are not so frequent, and since the gross features in different types of infection and injury are often similar, these studies were deemed advisable. At the Hospital for the Ruptured and Crippled the opportunity for procuring synovial tissue is unusually fortunate, and a considerable collection of microscopic material has been accumulated by the pathological laboratory. A study of that material forms the basis of this paper, and only those diseases represented in these specimens will be discussed in detail. For purposes of differentiation the histological features of diseases studied by others will be referred to briefly. This work has been done under the supervision of Dr. W. H. Probert, pathologist, and director of laboratories of the hospital.

Before discussing pathological types, it will be proper to describe the normal as we have found it. Synovial tissue from any one joint bears so close a resemblance to that from other joints when examined microscopically that it cannot be differentiated. This applies both to normal and diseased tissue. We have specimens from knees, hips, wrists and elbows.

NORMAL SYNOVIA

The synovia is a connective-tissue membrane lining a fibrous capsule. Between the two is a variable width of fibro-adipose tissue containing blood vessels, lymph vessels, and nerves. This is usually referred to as the subsynovial tissue.

The synovial membrane is composed of rather dense connective-tissue elements, mostly collagen fibers, and the usual cells of such tissue, *i.e.*, fibroblasts and mononuclear wandering cells. Toward the parietal side this layer merges into the subsynovial stratum by a rapid transformation into loose areolar tissue. Toward the joint cavity it becomes more compact, with a progressive diminution of intercellular spaces, until at the margin it presents an almost solid mass of cells.

The observations of Key[1] of St. Louis in 1925 on the regeneration of synovia in rabbits have been confirmed in part by us. The inner layer of the synovial tissue is not a row of wall-linked cells, but "may be likened

*This work has been done on the First Orthopaedic Division, Service of Dr. Royal Whitman, and in the Department of Pathology of the Hospital for the Ruptured and Crippled, New York City.

to field-stones. Some are on the surface, some partly buried, and others wholly covered by the collagen matrix".

We have never been able to demonstrate a special secretory layer of cells lining the synovial cavity. Nor have we seen any reason for assuming a vital mechanism for synovial secretion. Further, the nature of synovial fluid requires no such apparatus. It is a transudate from the tissue fluids and therefore a vascular lymph-linked system. Studies in the chemistry of this fluid by Cajori *et al*[2] show the close relationship existing between its chemical constituents and those of the blood. They were able to vary its carbohydrate content directly with variations in blood sugar following the ingestion of glucose. It is pertinent to note that this assimilative power of the synovial fluid was lessened in the presence of certain demonstrable joint lesions. Cytological studies by Key[3] further emphasized its transudate nature by noting the appearance of leucocytes and wandering connective-tissue cells.

Hence in the synovial membrane we have a lining of a potential cavity formed embryologically by a split in the mesoderm, and composed entirely of connective tissue. This membrane is permeable to tissue fluid and is subject to the same inflammatory and other reactions of connective tissue elsewhere in the body.

The subsynovia is composed of a loose fibro-adipose tissue. Its amount varies with its location; great in the alar fat pads, less in the parietal areas. In this tissue run the blood and lymph vessels which feed the joint and the corresponding nerves. It is a relatively highly vascular tissue. This vascularity in a susceptible peripheral circulatory system accounts for the rapidity of effusion in and about the joint. We feel that this stratum has not been sufficiently appreciated in the pathology of the arthritides. The vessels, embedded as they are in loose fibrous tissue, are capable of considerable dilatation. As will be shown later, they take a demonstrable part in the microscopic picture of each reaction described.

TUBERCULOUS SYNOVITIS

This term is used here to denote those cases in which tuberculous tissue — tubercles or tuberculous granulation tissue — is demonstrable in the synovia. Inasmuch as we have confined our studies to the reaction of this tissue alone, we are not concerned with the still mooted question of tuberculosis of the synovia without bone involvement[4, 5]. However, we may state in passing that several of our sections have been taken from cases showing no discovered bone infection. Watson Cheyne[6], to whose description of synovial tuberculosis in 1895 we have, today, very little, if anything, to add, claimed to be able to differentiate primary and secondary involvement. In the former, he says, the tubercles are found in the deeper layers and ulcerate toward the joint; in the latter the joint surface is covered with them. We are unable to confirm or deny this. In one of our hip cases, which we have every reason to suspect of being primarily

synovial, if such really exist, the tubercles are arranged for the most part immediately beneath the surface, but several deeper tubercles are also seen, and in the subsynovia are numerous perivascular and vascular-adjacent clumps of lymphocytes. The difficulty in deciding the possible existence of synovial disease is still to be overcome.

Tuberculous synovitis presents in micro-examination a varying and variable picture. This is due to the chronic progressive nature of the

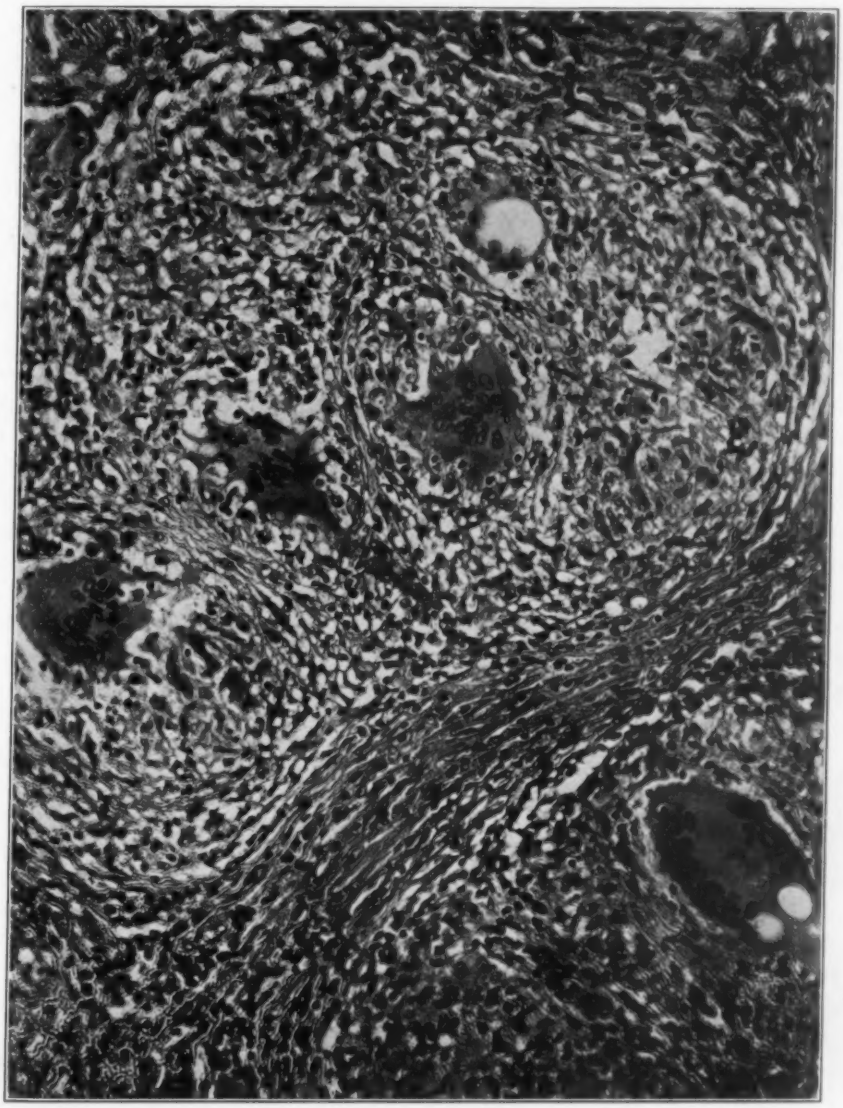

FIG. 1

Tuberculosis of synovial tissue, high power. Note the presence of one giant cell of the foreign body type, *i.e.*, with centrally placed nuclei. They are not infrequently found in these specimens.

tissue reaction. This progression may advance to the end-point of caseation, ulceration, or calcification, or may be halted at any phase by a healing fibrosis.

It has been stated[7] that before actual tubercles can be seen there is a thickening of the synovial tissue. This has not been observed by us, and we have read of no such report in which an entire synovia has been serially sectioned. Hence we will start with a specimen in which a definite tuberculous reaction can be demonstrated.

There is present in such a section a thickened synovial membrane, with cellular hyperplasia, and increase in the collagen fibers. The cell nuclei are deeply stained with hematoxylin-eosin, the matrix tightly packed. In the subsynovial layers there is a variable amount of fibrosis, variable with the duration and intensity of the infection. In later sections this subsynovial fibrosis appears confluent with that of the synovial membrane. There is a marked increase in the vascular bed, and a lymphocytic infiltration. This infiltration is frequently perivascular, and may suggest a syphilitic infection, until more characteristic elements are found.

We do not classify as tuberculous any section from a diseased joint unless tubercles or tuberculous giant cells can be demonstrated. In each section taken from a tuberculous synovitis, whether or not bone involvement was manifest, tubercles, or the characteristic tuberculous giant cell with peripherally placed nuclei, have been found in the tissue. Occasionally in the early or old "healed" phases of the disease, these elements because of their paucity may be difficult to find. Such cases are frequently missed and a diagnosis of non-specific synovitis made. Closer examination, however, in the true cases has always disclosed at least the incipient tubercle, — *i.e.*, focal areas of necrosis, perhaps small, occupied or surrounded by so called epithelioid cells; or the fibrosed remnants of an old tubercle. Where the case is clinically suspected of being tuberculous, prolonged search through numerous sections from different parts of the specimen is necessary before a negative diagnosis can be given.

In one of our sections a singie field presented several typical giant cells with one containing centrally placed nuclei. However, the absolute preponderance of the tuberculous type of giant cell was evident.

In more advanced cases areas of necrosis were seen, some superficial and some deep. Mature tubercles are frequently present. The formation of rice bodies has been extensively studied by others. Their appearance is highly suggestive, but not, as many authors believe, pathognomonic of tuberculous infection. They are found particularly in tenosynovial cavities, but are also present in the joints. For a consideration of their mode of formation we refer to Rogers' paper[8].

We may mention a case of tenosynovitis of the wrist joint tendons in an adult man from which literally thousands of rice bodies were expressed. Prolonged search failed to disclose any of the elements we demand for diagnosis of tuberculosis, and therefore, in the absence of any other specific lesion, we considered the condition to be one of non-specific tenosynovitis,

probably hematogenous. Subsequent uneventful healing, and a follow-up of several months has so far maintained our opinion.

We have examined several specimens from old-standing cases, where a joint, supposedly cured some years previously, again began to present symptoms. In these sections the synovia and subsynovia show extensive fibrosis; a small amount of lymphocytic and monocytic infiltration; and invariably some necrotic foci, apparently a tubercle, with one or more

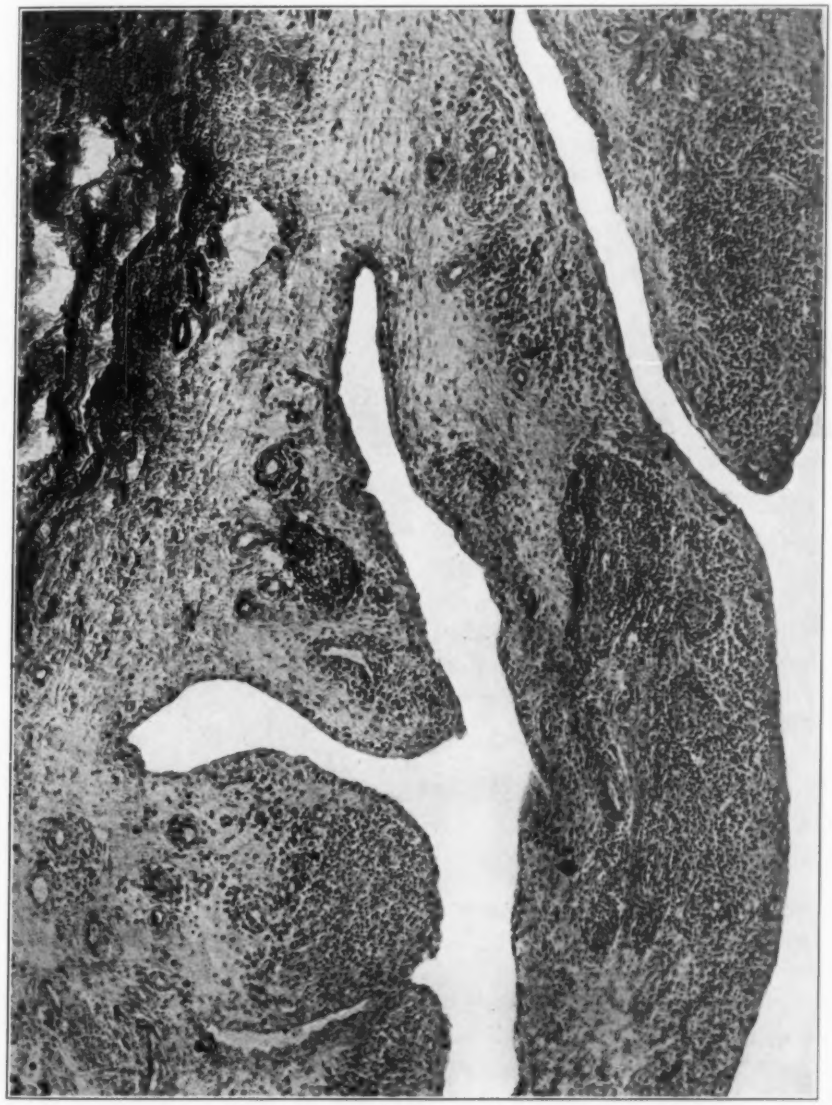

FIG. 2

Subacute synovitis, low power. Cellular infiltration of the synovia, perivascular infiltration, hyperplasia of the villi, and subsynovial fibrosis.

tuberculous giant cells present. These foci sometimes appear fresh as though from a reinfection, but usually are more or less invaded by fibroblasts, and suggest a still unorganized focus from the original infection. This picture of extensive fibrosis, slight cellular infiltration, and few tubercles is the one referred to in the literature as tuberculous granulation tissue, or healed tuberculosis.

When not halted by this fibrosis, the tubercles act as they would in any other soft tissue. They proceed to ulcerate, or caseate. They may open toward the capsule or toward the joint cavity. Those placed deep in the subsynovial tissue may easily invade any of the numerous blood vessels of this very vascular tissue. This process is the source of generalized miliary tuberculosis, when that catastrophe supervenes a chronically localized joint disease, a factor feared greatly in the Continental clinics.

We have no specimen showing true calcification of a nodule in the synovia or subsynovia.

This variable but fundamentally characteristic group of findings makes the microscopic diagnosis of tuberculous synovitis so definite as to allow a relatively small margin of error. In many cases perseverance is necessary, but we no longer find it necessary in our laboratory to accept atypical forms. The determination of a doubtful case rests upon a reasonably prolonged search through a number of sections. If no tubercles, tuberculous giant cells, or foci of epithelioid cells are found, the section is not labeled tuberculosis.

NON-SPECIFIC SYNOVITIS

We will discuss under this head acute, subacute, and chronic inflammation of the synovial tissues, in which the reaction presents no characteristic differential such as tuberculosis, syphilis, or local pyogenic organism. Coincident bone involvement will be mentioned only as it becomes necessary to explain some point in connection with synovial infection. Most of these sections represent the chronic arthritides, but we will try to avoid the many-sided problems of their etiology which would take us too far afield. However, the inflamed synovia differs in no way from any other area of connective tissue in its reaction to irritation, whether provoked by trauma, toxins, infection, or allergic phenomena.

ACUTE SYNOVITIS

The specimens representing this condition are naturally very few. Our earliest section is from a knee joint having a history of some pain for six months. During this time the joint become swollen and tender. The present complaint of marked disability was of several weeks' standing. There was definitely no history of trauma. Synovectomy was performed; at this time fifty cubic centimeters of straw-colored fluid was removed at operation.

Microscopic examination shows slight, if any, thickening of the synovial tissue. The cellular infiltration, predominantly polymorphonuclear, is for the most part confined to the synovial membrane. The subsynovia immediately adjacent is also somewhat infiltrated, but much less intensely. The vessels of the subsynovia are engorged, some are dilated, and those nearest the joint cavity show considerable perivascular leucocytosis.

The reaction of the subsynovial vasculosus varies in intensity, of course, but we find it invariably. This variation follows the degree of tissue reaction about the joint. Its relation to the intra-articular, or periarticular effusion has been mentioned. We cannot avoid emphasizing the importance of the circulatory mechanism of the subsynovia. There is anatomically all possible reason for a disturbance of this mechanism, especially about the knee joint. Since this paper is concerned only with the pathology of the synovial tissue, we hesitate to follow the obvious line of reasoning which a consideration of the circulatory factor suggests.

SUBACUTE SYNOVITIS

The microscopic picture resembles that of the acute type, but the tissue is moderately thickened, and the vascular reaction is usually not so intense. There is some hyperplasia of the synovial villi; the cellular infiltration is still polymorphonuclear. There is frequently some degree of perivascular fibrosis in the subsynovia. This condition is found in those joints subject to recurrent internal trauma, such as dislocating menisci, or deranged motility of the intra-articular fat pads. The fibrosis is usually not sufficiently advanced to affect the natural elasticity of the soft tissues. Hence, if the causative factor is removed within a reasonable time there should be practically complete restitution of normal function.

CHRONIC SYNOVITIS

We place in this category all those sections found in chronically inflamed joints; specimens taken from therapeutic synovectomies, joint fusions, etc., where the usual greatly thickened, fibrotic synovia is present. Sections are made from the synovia proper, and frequently from the mass of articular pannus, representing prolongations of the tissue as granulation material. For the most part these cases come under that group of arthritides termed hypertrophic, proliferative, atrophic, and degenerative. Regardless of the eventual outcome of studies in their etiology, the observed effect in the synovial tissues is, within a reasonable range, always the same. Gross examinations of such joints may show extensive bone and cartilage changes, or rarely, only synovial pathology. In either case, the present study deals only with the reaction in the synovia, and merely mentions coincident bone involvement.

The histologic appearance of such a section is that of a tissue reaction to more or less persistent irritation, but whether that irritation be infectious, allergic, or traumatic, is not visibly evident. We have seriously

attempted in this laboratory to differentiate cases of so called infectious polyarthritis from the atrophic arthritis of old age, but in our specimens various degrees of hypertrophy, and proliferation of the villi go hand in hand with more or less atrophy of bone, osteophytic growth, and cartilaginous degeneration. The differences are those of degree; we have not so far convinced ourselves from histopathologic observations of a difference in kind.

FIG. 3

Chronic non-specific tenosynovitis of flexor tendons of the hand and wrist, low power. Note the early stage of rice body, and absence of any evidence of tuberculosis.

The typical picture is that of a thickened synovia, its normally loose subsynovial connective tissue densely fibrosed. The cellular infiltration is not of the intense leucocytic type found in the acute stage, but the usual chronic soft-tissue inflammation, with its attending fibroblasts, and wandering tissue cells; with clumps of leucocytes, both polymorphonuclear and lymphocytic, arranged near or surrounding the blood vessels. There may

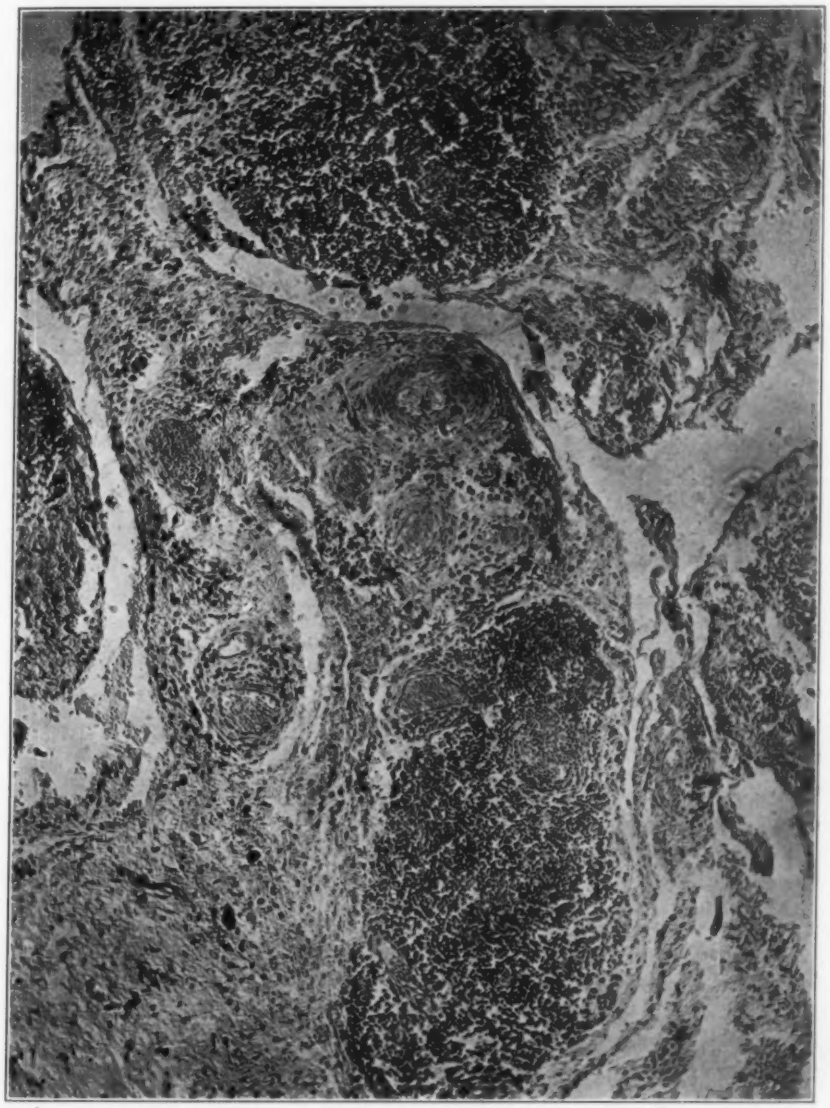

FIG. 4

Chronic non-specific synovitis from a case of poly-osteo-arthritis. Specimen taken from knee joint. Low power, subsynovia. Note the increase in vascularity, the tendency for clumping of the cellular infiltration, the perivascular fibrosis distinct from the generalized hyperplasia of connective-tissue elements.

be local areas presenting a more acute picture, since often the causative factor is still present, or the already thickened membrane is constantly irritated by intra-articular trauma. The villi may reach tremendous proportions, composed of dense fibrous tissue. It is in these enlarged villi that the early cartilage metaplasia leading to future joint mice is said to be observable. In our specimens we frequently see areas of hyalinization, but never actual cartilage in the synovia. However, we cannot deny their possible presence in other cases, but because of the several contradictory theories, we merely record our negative observation.

Pemberton *et al*[9], in discussing the pathology of arthritis, interprets the condition as a disturbance of the peripheral blood supply, resulting from focal infection. In every case of chronic arthritis in which we have examined the synovia histologically, there has been observed an obvious abnormality in the blood vessels of the subsynovia. Invariably the number of vessels present per field is increased. In some of these can be seen obliterating proliferation of the intima, occasionally canalized, fibrosed. Perivascular fibrosis, definitely demarcated from the general fibrosis, is always a noticeable feature.

This pathologic condition in the vascular bed is part of the joint reaction. The perivascular fibrosis tends at times to constrict the vessels; this in turn causes an increase in the corollary circulation, and fresh vessels are formed. During this process, of course the nutrition of the joint is seriously impaired. A vicious circle is formed and a progressive chronicity maintained. The participating of the articular vasculosus in the pathology of these affections accounts for the relief of symptoms obtained by the use of vasodilating drugs such as the nitrites, or the use of iodide preparations for their "tonal" effect on the circulatory apparatus.

We cannot agree with Allison and Coonse[10] that the synovial membrane bears more than a secondary relationship to chronic synovitis. We are convinced from our observations of the histopathology of this tissue and its anatomic peculiarity that the manifestions are secondary to a systemic involvement, and that the local reaction is due to a disturbance in the vascular mechanism of the subsynovia.

ACUTE PURULENT SYNOVITIS

This may follow direct infection through a wound, or may be blood-borne from a distant focus, or may complicate osteomyelitis in a contiguous bone. The common organisms involved are staphylococcus albus, and staphylococcus aureus, or various strains of pyogenic streptococci. In addition gonococci, pneumococci, the organisms of scarlet fever, enteric fever, and some other specific infections may be concerned.

The histopathology varies from an acute inflammatory synovitis to severe pyogenic destruction. After the early inflammation (as described above) an effusion appears within the joint cavity. This soon becomes purulent, the leucocytic infiltration of the tissue increases, and areas of

necrobiosis, in the form of small distinct abscesses appear. These enlarge, necrosis of the surrounding areas spreads, until the reaction has been completed or halted. The destruction may reach pan-articular proportions and leave in its wake the wildest picture of dense fibrosis and irregular gross adhesions. When the case has not been as extensive, the proliferation of fibrous tissue may be the only residue, or a chronic low-grade synovitis may remain. In the latter case there is usually a bone focus to be sought near by.

SYPHILITIC SYNOVITIS

We have no specimen of this in our collection. It does not occur as an only lesion of spirochetal infection. Characteristic in the synovia is the perivascular infiltration of lymphocytes, and the formation of small or large gummata. It is mentioned here merely as a differential possibility. It may be easily confused with tuberculous granulation tissue in the synovia, and examination of the joint of a patient in whom a positive Wassermann has been found requires careful consideration. A systemic luetic infection does not necessarily convict the synovial membrane. However, synovial lues has always followed that of bone, and this fact is of great significance to the pathologist.

OSTEOCHONDRITIS DISSECANS

This must be mentioned in connection with synovial tissue lesions. The histopathology of joint mice varies from hyalinized connective tissue to well formed bone. Hypertrophic synovial villi are the source of those with obvious fibrous composition. Whether the cartilaginous and osseous types are formed of disjointed bits from the adjacent bone or are the result of metaplasia of the synovial elements is still a much disputed point. We have never seen true cartilage in the synovia. It is of course possible that the loose body of synovial origin may, after hyalinization, become calcified while lying free in the synovial fluid, or may even cohere to the synovial wall.

SYNOVIOMATA

Smith[11] reports this neoplasm of synovial tissue. We have never seen one, but we have carefully studied the cases he has described. They were characterized by two cell types, synovial lining cells and stromal cells, with intermediate forms. The so called lining cells are, as we have pointed out, the inner surface of the synovial membrane, and are not distinctive. In every case the patient died of pulmonary metastases within a short period, six months to two and a half years. From what we have consistently maintained in this paper, it is clear that these tumors must be classified as sarcomata originating in the synovial tissues.

Ewing[12] does not refer to this terminology (synovioma) but does describe lipomata emanating from the fat pads of the synovia, especially in the knee joint.

RHEUMATIC FEVER SYNOVITIS

Homer Swift[13] in his observations on the general distribution of Aschoff's bodies in rheumatic fever refers to specimens of synovia removed at biopsy early in the course of the acute arthritic symptoms of this disease in which he found "small areas of necrosis surrounded by cells in various stages of necrobiosis". He considered these modified Aschoff's bodies.

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CYSTIC BURSAL HYGROMAS

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LITERATURE

The term "hygroma cysticum patellare" was coined by Schreger about 1825. Following his work the idea became accepted that cystic hygromas of the prepatellar region arose by exudation of serous fluid from the free, inner surface of the bursa in a manner comparable to the formation of hydrocele from the tunica vaginalis of the testis.

According to Langemak, Virchow was the first to shake the old theory that a bursa was a serous sac, lined by epithelium, and containing secreted fluid. He held firmly that hygromas, as well as the inconstant bursae, developed by atrophy of tissue. He recognized the tissue trabeculae (*Balken* in the German) which we see stretching across the bursae, and identified the tubercles on the walls (*Höcker* in the German). He declared that a part of these tissue trabeculae and tubercles arose by atrophy of tissue described as *"Erweichung"*, *"Schmelzung"*, and *"Colliquation"*. On the other hand, he described the presence of actual outgrowths from the bursal walls into the cavity, and differentiated "hygroma proliferum" from other similar growths. Langemak pointed out that Virchow did not recognize the preliminary connective tissue hyperplasia that comes before the liquefaction. Virchow described rice bodies that he considered to be necrotic excrescences from previous proliferation of the bursal wall.

Schuchardt, in 1890, described carefully his observations in the case of a hygroma on the external malleolus of a tailor. Schuchardt's work was important in that he recognized preliminary connective tissue hyperplasia followed by a process of liquefaction. He found mitosis in the regions of proliferating connective tissue. He described the multilocular structure of this tumor, a point important in determining that the cyst does not arise from the original bursal cavity. In describing the microscopic appearance of the structures in transition from connective tissue to liquefaction, he spoke of the appearance of fibrinous strands, staining blue with Weigert's stain. He described the process as an inflammatory production of new tissue, with the development of fibrinous inflammation and a fibrinous exudate arising within the inflamed tissue, even within the tissue cells themselves. He pointed out that Virchow had asserted years before that the fibrinous exudate was not to be considered as coming from the blood, but that it was a product of chemical activity in the tissues.

The studies made between the time of Schuchardt's article in 1890 and 1903 were carefully reviewed by Langemak, who, in the latter year, published an article on the origin and development of the hygroma. Langemak's ideas did not agree with those of Schuchardt in regard to the fibrinous exudate. He believed that the intermediate product between connective

tissue and the liquefied material was a purely degenerative substance and not a fibrinous exudate as Schuchardt had held. To this intermediate product of degeneration the term "fibrinoid" had been applied previously by Neumann, who also believed it to be a product of degeneration of connective tissue rather than an exudate. The distinguishing quality of this fibrinoid material was the fact that it stained yellow instead of pink with van Gieson's stain, a stain that ordinarily colors connective-tissue fibers a deep pink or red. Langemak spoke of the observers who confirmed Neumann's views about fibrinoid tissue, mentioning Ricker, Schuchardt, Goldmann, and Garrè.

Langemak took exception to the idea that any proliferation of tissue could take place on the inner surface of hygroma, as had been held by Virchow and later by Ottiger (under Ribbert's direction) and also by Graser. He could see nothing to indicate proliferation and wished to avoid entirely the term "bursitis proliferans". Langemak's ideas of the production of rice bodies differed from Virchow's principally in that Virchow spoke of proliferated tags which separated from the bursal wall to form the bodies, whereas Langemak held that the tubercles on the wall of the bursa were entirely degenerative in origin. Langemak stated that he believed that layers of fibrinoid tissue thrown from the necrotic bursal wall could form rice bodies. He also emphasized the significance of liquefaction in the development of rice bodies. It will be apparent, later, how these ideas coincide with the observations in the cases of the writer's series.

Compared with the German literature, that in English is to a great extent wanting in an accurate portrayal of the pathologic processes involved.

Tubby, in 1899–1900, showed evidence of close observation of clinical and gross pathologic data, but evidently he did not know about, or did not appreciate, the work that had been done in Germany during the preceding ten years.

Churchman, in 1909, in an extensive paper entitled "Luetic Bursopathy of Verneuil", gave an excellent review of the literature on hygromas in general, including an extensive consideration of the available knowledge in regard to the related embryology and anatomy. He reviewed twenty-eight cases of what he considered to be syphilitic manifestations in bursae. Simple hygroma was listed eight times; gummatous bursitis, ten times; ulcerating or fungous bursitis, five times; and acute inflammation, three times. His work was a warning that one should be ever on the lookout for evidences of syphilis in the ordinary hygromas, and should make use of all the diagnostic aids in finding or ruling out syphilis in each case in which one or more bursae was causing trouble. He told of brilliant and rapidly attained results in certain cases in which antispecific treatment was used. He had no pathologic material to present, so it is not certain how closely syphilitic and gummatous involvement of bursae simulate the hygromas which were studied.

Many of the articles of more recent times have to do with short reports of cases of hygroma, and do not go deeply into the subject. Mention should be made of the article by Kummer, in 1917, who reported a large cyst of the iliopsoas bursa, examples of which do not appear in the series presented below. He reviewed the literature on the subject. Earl, in 1918, considered the bursae from the anatomic, histologic, physiologic, and clinical aspects. Gatch and Green, in 1925, reported a case of cyst of the iliopsoas bursa and reviewed the literature on the condition.

Some of the articles that have to do with particular phases of the subject will be left for consideration when these particular points are considered.

ANATOMIC CONSIDERATIONS

Knowledge about bursae is of comparatively recent origin. Churchman said that Albinus, in 1734, described sixteen pairs of sacs between tendons and bones and called them "bursae mucosae", but he (Churchman) stated that Winslow had previously observed bursal sheaths about the tendons of the ankle and wrist. Dömény quoted W. Gruber's statement that Peter Camper, in 1780, discovered the olecranon bursa. Monro, in 1788, published in Edinburgh "A description of all the bursae mucosae of the human body". Béclard was one of the early anatomists who studied the bursae carefully; his book on anatomy appeared in 1823. Schreger, in 1825, published an extensive work on the subcutaneous bursae mucosae, but Dömény, judging from Luschka's book, thought that of the unbelievable number described, many were artifacts. Henle, in 1838, held that the articular lining and bursal lining consisted of epithelium (*Epithel*). Hueter considered the synovial membrane a connective-tissue membrane. Virchow was greatly interested in bursae, and Churchman quoted his idea that "the bursae are in no sense true serous sacs, . . . but are rather places where the connective tissue, originally present in continuo, forms spaces by a process of atrophy, and where these spaces come, in time, to be independent cavities". Kölliker, in 1850, described the bursae as connective-tissue sacs enclosing a fluid. About the same time the bursa mucosa prepatellaris profunda was discovered by Luschka. He thought it more than a connective-tissue space and argued that the "epithelial" covering which he found did not indicate a mere space but had to do with the formation of a specific secretion. In 1851, he described the bursae as typical serous sacs, although often he could not find the so called epithelium and explained the lack of epithelium as a pathologic condition resulting from inflammation. Heinecke, in 1868, concluded that the deep bursae, especially those communicating with the joints, were early formations, developing in the embryo, whereas the superficial bursae, especially those which were subcutaneous, became acquired in the course of time. Hammar, in 1894, and also Braun, claimed that the lining was not epithelium, nor endothelium, but real connective tissue. Edward Retterer, in 1895, told of his extensive observations of the embryology of bursae as observed in rabbit embryos,

and Dömény, in 1897, published careful observations on the development and formation of human bursae. Special reference to these two latter works will be made in the embryologic consideration.

Piersol has said that bursae are sacs filled with fluid found in various places where friction occurs between different layers or structures. In the widest sense, this would include the pleural, pericardial, and peritoneal cavities, but the present study is concerned with the bursae of the locomotor system. The tendons usually are surrounded by bursae and according to Piersol's definition the joint cavity itself is a bursa. The necessity for limiting my subject has led me to exclude these two types from consideration. Piersol classified bursae as synovial and mucous.

The synovial bursae are represented by the joints and tendon sheaths, where a true synovial lining is present. The stratum synoviale is the distinguishing feature of what is understood by "true synovial lining".

The mucous bursae (the *Gleitbeutel* of the Germans) are represented by the subcutaneous bursae,—for instance, those situated at the point where the skin at the elbow or knee is subjected to stress. Piersol has said that the mucous bursae are little more than exaggerations of the spaces between layers of areolar tissue. He mentioned the fact that this classification holds only in typical instances, for one type merges into the other, with all gradations between. Morris gave the following gradations: (1) subcutaneous bursae which are beneath the skin; (2) subfascial bursae which are beneath a fascia; (3) submuscular bursae which are between two muscles, between a muscle and some skeletal part, or between a muscle and a tendon, and (4) subtendinous bursae which are between tendon and bone, between tendon and ligament, or between two tendons.

There are a number of prepatellar bursae: the bursa prepatellaris subcutanea is beneath the skin, over the lower half of the patella; the bursa infrapatellaris subcutanea is beneath the skin over the proximal part of the patellar ligament; the bursa prepatellaris subfascialis is beneath the fascia lata, in front of the patella; the bursa beneath the inner head of the gastrocnemius muscle is a submuscular bursa; and the bursa beneath the common tendon of the sartorius, gracilis, and semitendinosus, on the anteromesial aspect of the head of the tibia, is submuscular. An intimation of the great number of bursae that exist, as well as the variations that must be possible, has been given by Churchman in describing the bursae about the knee and elbow.

Much discussion has taken place as to whether or not the bursae have a synovial lining. Piersol has said that the mucous bursae are provided with a more or less cellular lining, less perfect than the bursae in the synovial group. The degree of perfection of the synovial lining must vary in completeness, from the less differentiated superficial bursae to the more highly differentiated joint cavities. The stratum synoviale is the portion to which reference is made in considering the synovial membrane. In the joints, where the synovial membrane is best developed, it consists of loose connective tissue containing blood vessels, lymphatic vessels, and fat.

Hammar differentiated two kinds of connective-tissue cells in the stratum synoviale: star-shaped cells with plentiful protoplasmic processes, and other, more superficial cells, that tend to be more spherical. He found that the spherical type of cell did not rest on the connective tissue but lay within it. According to Hammar and, also, Braun, the covering of the synovial membrane is neither epithelium nor endothelium, but real connective tissue. In Lewis and Stöhr's book on histology these covering cells have been spoken of as mesenchymal epithelium. As objections have been expressed against the terms epithelium and endothelium, perhaps the term mesothelium would be more suitable.

Key has shown definitely that the synovial membrane can be developed in situ from the connective tissue which remains after partial synovectomy; hence I have been led to believe that the synovial membrane, or stratum synoviale, with its mesothelium, merely represents slightly specialized connective tissue, lining a tissue space.

EMBRYOLOGIC CONSIDERATIONS

The first thoughts that come to mind concerning bursae usually have to do with gross anatomy, but it is when one digs deeper into the embryology that a better understanding of the gross and microscopic anatomy is reached.

Retterer, in 1895, described his observations on the development of bursae as seen in rabbit embryos. He differentiated five main stages of development: (1) primordial connective tissue, consisting of homogeneous protoplasm with nuclei, but not containing cellular units; (2) fibrillae deposited in the elementary matrix or ground substance; (3) active mitosis, and the production of a network by the cells; (4) disappearance of the cells lying in the mesh, and (5) disappearance of the fibers forming the network and resultant formation of a cavity. These observations were made in rabbit embryos, on the bursa between the Achilles tendon and the os calcis.

According to Dömény, if one studies the connective tissue in the region of an embryonic bursa, it is found to have a peculiar, swollen, gelatin-like appearance and under the microscope it may be seen that the "*Schleim*-substance" has penetrated the tissue in appreciable amounts. Reference to this appearance will be made later, in the consideration of the observations on one of the pathologic specimens which was removed from an adult person.

Dömény, in 1897, published the results of his observations on the origin and development of the superficial and deep bursae in the human being. Dömény could follow, in human embryos, the principal points of Retterer's observations in the rabbits. In the skin of the embryo, by low magnification, he saw two layers: a superficial, dense layer and a deep, looser layer. He found that the bursae developed in the looser stratum, and that the elements of the skin, such as hair bulbs and glands, developed in the denser stratum. He could find, in foetuses of four to six months,

these two strata presenting a similar appearance in the regions of the patella and olecranon. Over the olecranon, in the looser stratum, in a foetus of seven months, the cells were especially loosely arranged, but were connected by many fibrous processes. He noted that in a baby of two months the olecranon bursa was marked only by two connective-tissue spaces, under the layer of fat, and apparently the bursa first became distinct when the fat about the elbow of the child disappeared. Dömény described minutely the development of the superficial bursae about the patella. He said that the region between the quadriceps tendon and the epidermis disintegrates, in the embryo, into two definite, distinct cavities. He spoke of cellular trabeculae forming retiform spaces, and of a connective-tissue mesh of large, star-shaped cells connected with one another, which Retterer saw in animals. He described seeing connective tissue in conditions of complete atrophy and destruction. Between individual fibers which reached from cell to cell he saw a finely granular net, which he thought merely represented the coagulum derived from the substance between the cellular processes. He described a superficial, and a deep, prepatellar bursa. In the deeper bursa he found only a small amount of tissue, whereas the superficial space was more cellular. He noted that this observation was in line with the statement that the deep-lying bursae developed earlier than the superficial bursae, but he held that there was no special difference between the development of deep and of superficial bursae. He found the subachilles bursa present in the fourth or fifth month of foetal life.

Velpeau sought to explain the origin and development of bursae on a mechanical basis. Retterer pointed out that the anlage for some bursae was present before there was any chance of active movement of the embryo. Undoubtedly, however, active movement has a part in the development of bursae, as claimed by Virchow and Schuchardt, and may be judged from the conditions mentioned in the next paragraph.

The olecranon bursa (or bursae), and other bursae, particularly those that are superficial, really attain their identity as bursae after birth. This fact is important, for it helps, in a measure, to explain how, under certain environmental conditions, connective tissue may produce bursae in parts of the body where particular friction and pressure make them necessary. An example of this is shown in Case 45 of this study, in which a definite bursa was found over an exostosis of the tibia. According to Tubby, Verneuil mentioned the formation of bursae over tumors. Cases 16 and 36 illustrate the development of bursae in club-foot, in a place where a bursa normally is not found. Langemak and Tubby spoke of the bursa that is developed over the gibbus of Pott's disease, and of the bursa over a stump after amputation. In this connection, there might also be mentioned the bursae over bunions, and the cavities which develop in the false joints that are found in cases of non-union of fractured bones. Thus, consideration of the origin and development of bursae causes one to pay attention not only to embryonic life but also to adult life.

The embryologic development of bursae is closely allied to the development of joints, and joints may be considered to be highly differentiated and specialized bursae. According to Disse, the deep bursae in the neighborhood of the joints arise quite like the joints, by cavities resulting from solution of connective tissue. Figure 1 shows a portion of a section through the knee joint of a human foetus of thirty-three millimeters. By the time the foetus has reached this stage of development, the articular cavity has been well established, but even here I have found remaining a stellate cell, with fine fibrillar processes. It may be seen under the microscope that the cavity is filled with a substance which has taken the stain very faintly and homogeneously, and represents, I believe, the embryologic counterpart of the synovial fluid.

RECORDS OF CASES

Fifty-five cases of hygroma were chosen for study. In these cases, adequate records were available and specimens were at hand for investigation. The operations had been performed since 1906; most of them in more recent years, however. The specimens had been preserved in formalin.

Thirty-eight of the patients were males; seventeen were females. Excluding the three patients with club-foot and one with a bursa over an exostosis, the average age of the males was forty and one-tenth years, and the average age of the females was thirty-nine and eight-tenths years. The youngest patient was aged five years, and the oldest sixty-four years. The occupations of all were not known but the fifty-five patients included twenty farmers and five laborers, one of whom was a miner and another a blacksmith. Ten patients were merchants, salesmen, or clerks. Three were housemaids; three, nuns; and four, housewives. Of the patients referred to thus far, three had club-foot and one presented a bursa over an exostosis. There was also one child, one student, and one physician.

There were a number of points in the records which had possible bearing on the development of the condition. Severe trauma was recorded in nineteen cases; one of these patients was rheumatic. There was long continued, moderate trauma in eleven cases; one of these patients, also, was rheumatic. A definite negative history of special trauma was given in seven cases. Three of these patients were farmers. Trauma was not mentioned, either positively or negatively, in ten cases. Several patients complained of a rheumatic disorder. In ten cases it was of slight degree; in seven, of moderate degree; and in one case, of severe degree.

In several cases, the history of symptoms had bearing on the development of the condition. Pain and disability usually were mentioned as being slight, but occasionally the trouble was disabling (Cases 51 and 52 of the series). It was noticeable that in the nineteen cases in which trauma was very definite and of a severe type, several divisions could be made. In one division, of twelve cases, there was an original injury and later development of trouble. In nine of these twelve the original injury was followed

by a period of freedom from discomfort and then trouble arose; in two, the original injury was followed by a period of slight discomfort and then trouble followed a second injury; in one case, the original injury was followed by an interval of relief, and then more trouble followed a second injury. Another division was composed of patients who suffered an original injury, with tumor and pain dating from the time of injury and without an interval of relief; there were six of these cases. A third division included only one case. Trauma definitely had occurred in this case, but the history was not specific enough to enable it to be placed in either of the foregoing two divisions. The interval between the time when trauma occurred and the time when the patient came for relief, in the nineteen traumatic cases, varied from six months to sixteen and a half years.

There was a prepatellar bursa in thirty-eight cases: in eighteen cases it was on the right leg only; in fifteen cases, on the left leg only; in four cases it was bilateral; and in one case there was a left prepatellar bursa, associated with enlargement in the region of the right external malleolus.

The bursa was of sartorial or anserine type in three cases: in one case, it involved the right side only; in one case, the left side only; and in one case, there was a left sartorial bursa, associated with involvement of the left superficial pretibial bursa.

In four cases, the bursa was beneath the mesial head of the gastrocnemius muscle: in two cases, it involved the right side only; in two cases, the left side only.

There were three cases in which there were bursae in the region of the knee but the exact situation was undefined.

Bursae on the bearing surfaces in talipes equinovarus were found in three cases: in one case the condition was bilateral; in two cases, it appeared on the right side only.

The records of general examination in the fifty-five cases often were very brief, due to the obviousness of the condition. The diagnosis, at times, was given in the space provided for physical signs; however, the main signs recorded were as follows: fluctuation was recorded in eighteen cases; hard or firm tumor was noted in six cases; tenderness was present in four cases; tenderness was absent in twelve cases; local heat was noted in five cases; the mass was recorded as being movable in five cases, and as being fixed in three cases; the sensation of crepitus or of rice bodies was recorded in two cases; articular motion was free in eight cases, and limited in two cases in which the trouble was near the knee.

The Wassermann reaction of the patient's blood was recorded in twenty-four of the fifty-five cases. It was negative in twenty-three cases, and positive in one case. Chemical analyses of the fluid aspirated are described elsewhere in the text.

In three records, mention was made that aspiration had been done before the patients came to the clinic. Probably many more cases had been treated thus. Radical excision of the involved tissue was done in each of the fifty-five cases studied.*

*The cases in which operation was not done were not included in this study.

Information was received from twenty-four of the fifty-five patients indicating that the condition had not recurred. The time elapsing between the operation and receiving of the information varied from nine and a half months to more than fourteen years. In five cases the elapsed time was more than ten years; in eleven cases, it was more than five years. The average interval was five years and six months. The only suggestion of a recurrence was noted by one patient who reported a small, hard subcutaneous mass that had not caused trouble.

The pathologic material studied was classified according to the relationship between the proliferation and liquefaction present. Both proliferation and liquefaction were well recognized in the literature, but the liquefaction and disintegration have often been stressed and made to seem more important than the preliminary proliferation. Probably the reason for this is that cases in which there is proliferation have been seen less frequently; most of the patients who come for operation present a late stage of the process. The importance of the proliferative stage is emphasized, because it was by a study of this part of the process that something of the relationship of hygromas to other pathologic developments from connective tissue could be determined, and the later changes so frequently seen at operation could be explained.

The classification of the types of cases is given in Table I.

TABLE I

CLASSIFICATION OF TYPES OF CASES OF CYSTIC BURSAL HYGROMAS

Types	*Distinguishing Characteristics*
1. Early	Proliferation of embryonic connective tissue, with widespread and probably rapid liquefaction.
2. Intermediate	Proliferation of connective tissue of a kind more differentiated than Type 1, with liquefaction less widespread, and probably slower than Type 1.
3. Late (including dissimilar end-products depending on environmental conditions at hand).	
a. Necrotic.	Proliferation practically stopped; fully differentiated necrotic connective tissue at hand, with liquefaction that was probably still slower.
b. Differentiated bursa (approaching normal).	Differentiation of tissue, rather than necrosis has been dominant; approach to normal bursa seen; stratum synoviale evident (environment important, particularly as regards blood supply).
c. Resting	Avascular fibrous capsule forming wall of cyst; proliferation and liquefaction practically at a standstill.
4. Combinations of any of Types 1, 2, 3*a*, 3*b* and 3*c*.	

Following this classification, it is in order to describe the data in particular cases which established the rationality of such a classification.

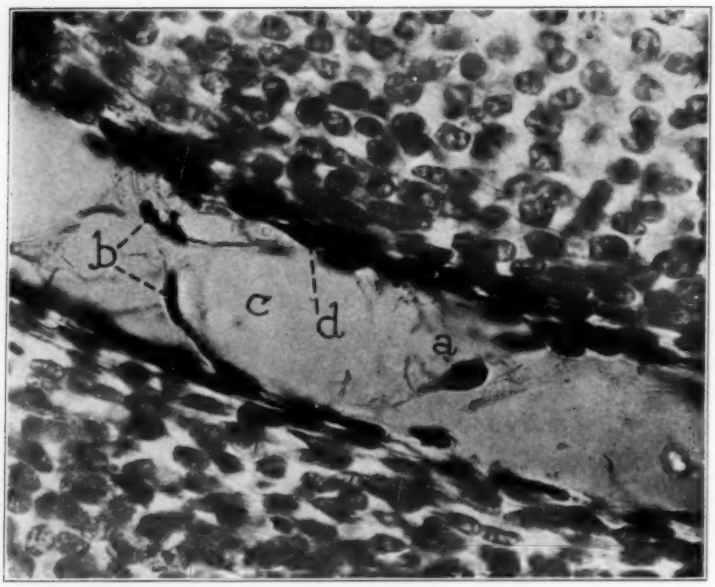

FIG. 1

Sagittal section of a knee joint of a human foetus of 33 mm. (× 700). *a*. Stellate cell with processes, in joint space. *b*. Cells more degenerate than those at *a*. *c*. Homogeneous lightly stained material evidently from fluid filling joint cavity. *d*. Anlage of articular surface of femur.

Hygromas of Type 1. Only one case was found to represent the early or embryonic type. It filled a distinct gap in the classification and was important in obtaining a well rounded and connected understanding of the pathology of bursal hygromas. The protocol follows:

Case 1 (Case 51 of the series). December 17, 1927, a salesman, aged forty-nine years, came to The Mayo Clinic, complaining of pain and swelling in the region of the right knee. In March 1927, when trying to push an automobile, he had wrenched the knee and had bumped it against the ground. Immediately after the injury he had been conscious of a sharp pain, and had noted a swelling over the inner side of the head of the tibia. The pain had subsided in a few days but the swelling had remained stationary. November 2, he again had wrenched and hit the same knee against the ground. This had been followed by severe pain and extension of the original mass. It was his belief that the original enlargement (in the region of the anserine bursa) was associated with enlargement traveling around the inner side of the head of the tibia to the front (in the region of the superficial pretibial bursa over the tibial tubercle). At the time of his registration, the pain was constant.

General examination showed that the patient was well nourished, not acutely ill, and walked without a limp. On the mesial aspect of the head of the right tibia, in the region of the anserine bursa, and over the tibial tubercle anteriorly, were fluctuating swellings. The enlargements were tender and painful. There was pain in the region of the right knee when the knee was acutely flexed. Other joints were not involved.

Aside from nerve deafness and fibrous tonsils the remainder of the examination gave essentially negative results. The urine was negative to examination. The leucocyte count was 14,000 for each cubic millimeter. Various other blood tests, including a

Wassermann reaction, gave negative information. The roentgenogram of the right knee did not give evidence of abnormality.

December 21, 1927, under general anaesthesia, by a horizontal incision around the mesial side of the head of the tibia and extending across anteriorly, the anserine and superficial pretibial bursae were exposed. The anserine bursa contained colorless, jelly-like material. It was biscuit-shaped, about three centimeters across, and unilocular, with relatively smooth walls. Extending between the anserine bursa laterally, and the pretibial bursa anteriorly, was fatty tissue containing a number of small separate cysts filled with the same type of gelatinous mucoid material. Over the tibial tubercle there was a cyst about two centimeters in diameter, which contained pink, gelatinous mucoid material having the appearance of pink apple jelly. On the wall of this cyst was a blood clot which apparently accounted for the pink color of the cystic content. Near the anterior cyst was myxomatous-like connective tissue which had the gross appearance of connective tissue which had been infiltrated by a local anaesthetic solution.* The contents of the anserine bursa and of the superficial pretibial bursa were aspirated separately and the material was saved for chemical analysis. The following structures were excised: each cyst; the fatty tissue, containing small cysts, which

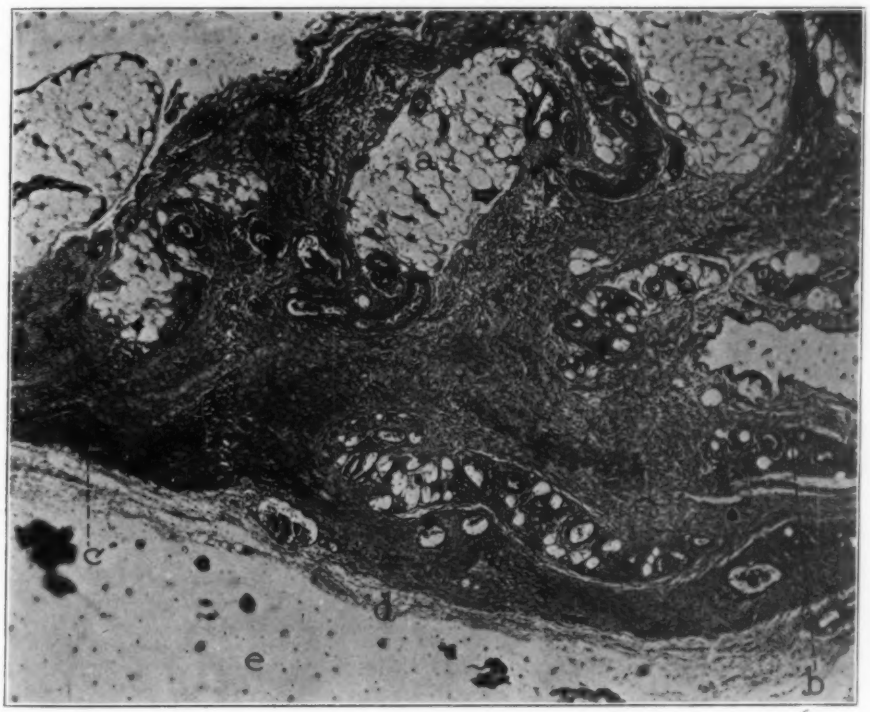

FIG. 2

Section of wall of cyst over pretibial tubercle (Mallory's phosphotungstic-acid stain) (× 30). *a*. Fat lobules in external part of wall. *b*. Fat lobules in wall of cyst, nearer cavity, showing proliferation of cellular connective tissue and evidences of atrophy of fat cells. *c*. Area of dense tangle of threads of fibrin stained blue by Mallory's phosphotungstic-acid stain. *d*. Degenerated necrotic tissue of wall of cyst. *e*. Cavity of cyst. Stained section indicated precipitated fluid containing cellular debris.

*Compare this with appearance of connective tissue in region of bursa developing in embryo as described by Dömény on page 49.

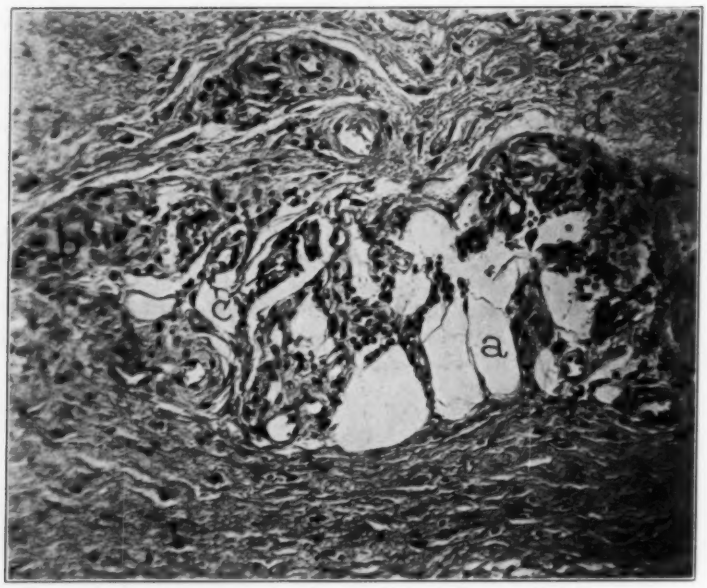

FIG. 3

Section of such a fat lobule as that shown in Fig. 2, *b* (× 150). *a*. Atrophic fat cells. *b*. Cellular connective tissue. *c*. Capillaries. *d*. Lymphocytes.

extended between the two large cysts; and the myxomatous connective tissue, near the anterior cyst. The superficial, infrapatellar bursa was questionable in appearance; so it, also, was excised. In no place did the cysts connect with the knee joint proper. The wound was closed, and two soft rubber drains were left in place. These were removed December 24, 1927, and January 5, 1928, the sutures were removed. January 13, 1928, the patient was dismissed.

Microscopic examination revealed a number of interesting features. Foremost among these was the close resemblance of the structure and arrangement of the cells in the formation of these cystic cavities to the appearances described by Retterer and Dömény in picturing the embryologic development of bursae. Proliferation of the connective tissue will first be described. Toward the external surface of the wall of the cyst which was over the pretibial tubercle (Fig. 2, *a*) were several fat lobules. Deeper in the wall of the cyst, nearer the cavity, these fat lobules apparently were in the process of being replaced by proliferation of connective tissue (Fig. 2, *b*). Proliferation of these young connective-tissue cells was closely related to the capillary blood supply, and as the fat lobules seemed to have the greatest number of capillaries, the proliferation was found mostly in the fat lobules (Fig. 3). Signs of atrophy and disappearance of the fat cells went hand in hand with proliferation of the connective tissue. This was pointed out by Langemak. The young connective tissue near the capillaries was distinguished particularly by the close grouping of the oval and round nuclei. No evidence of mitosis was found in the proliferating stage, but Schuchardt reported many instances of it.

Farther from the capillaries, and especially between the fat lobules, the connective tissue nuclei became farther and farther apart; they were separated from each other by bundles of fibrils which were in varying stages of liquefaction. The myxomatous-appearing tissue was found to consist of a very delicate rete or connective-tissue mesh of stellate cells, with long processes. Some nuclei were round; others were oval. They were surrounded by a definite endoplasm, in addition to the many fine intercellular

fibers which apparently lay in the liquid matrix. These cells may be seen in the region *a*, in Figure 4. This section also illustrated how the liquefactive process had allowed the fat to run in every direction, apparently because of the liquefaction of the supporting framework of the fat. Not only was the fat liberated, but near the surface of the cyst, where destruction of tissue was evident, there was often marked extravasation of blood.

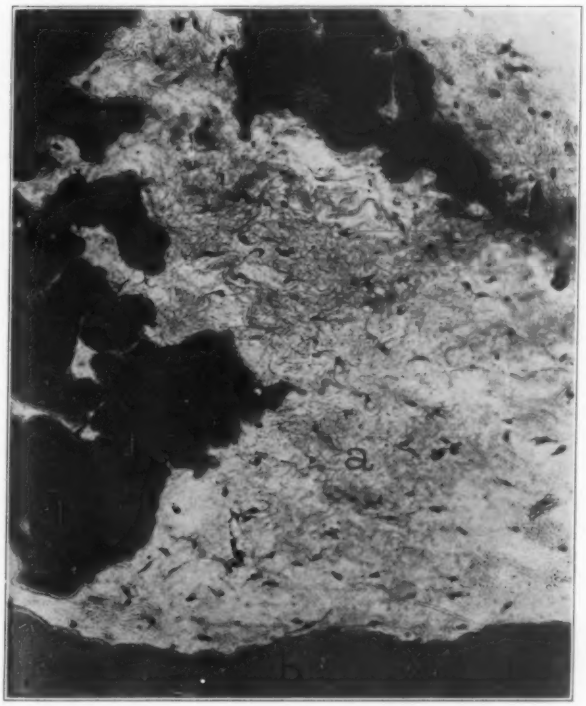

FIG. 4

Section of tissue with myxomatous appearance, stained for fat (× 75). *a*. Stellate connective-tissue cells, with abundant fibrillar, intercellular material with what seems to be an abundance of liquid. *b*. Fat without any framework or supporting tissue.

In the wall of the cyst that was in the region of the anserine bursa, numerous small regions of liquefaction of connective tissue were found (Fig. 5). Figure 1 is a portion of a section through the knee joint of a human foetus of thirty-three millimeters. This picture is included merely to emphasize the similarity of the structure of the cells in the development of the cystic hygroma in the adult to the embryologic development of a bursa in the embryo. Of course, the knee joint here is considered a bursa in the widest sense of the word. In this embryo, the articular space was well along in its differentiation; however, some of the rete cells remained, and resembled closely in structure the cells found in the space which is seen to be forming in Figure 5.

Besides the striking similarity between the development of cystic bursal hygromas and the development of bursal cavities in the embryo, it was surprising to see the similarity between the early stages of development of bursal hygromas and the early stages of development of cartilage and bone from the connective tissue of the stratum synoviale in synovial chondromatosis and osteochondromatosis.

Comment: The stages of development of cartilage in chondromatosis of the knee joint were shown in a former article (*The Journal of Bone and Joint Surgery*, IX, 310, April 1927). Figures 6, 7, 8, 9, and 10 illustrate the steps by which the undifferentiated connective-tissue cells come to have a fibrillated exoplasm which is replaced by the homogeneous matrix of cartilage. In Figure 9, the fibrillated exoplasm at *x* can be seen to merge directly into the homogeneous matrix at *y*. The degenerated nucleus of the original connective-tissue cell becomes the nucleus of the cartilage cell (Fig. 9, *z*). It is noticeable that these changes take place in tissue devoid of a capillary blood supply in contrast to the original undifferentiated

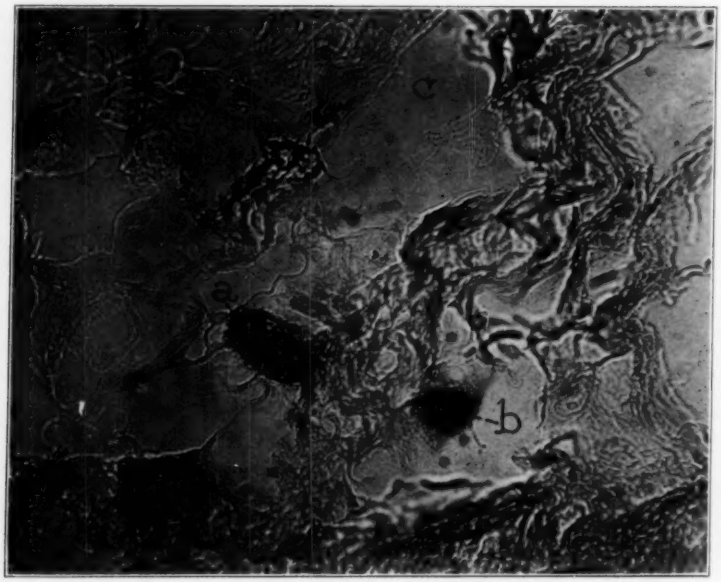

FIG. 5

Section through wall of cyst in region of anserine bursa. *a*. Cell with processes in area of liquefaction; resembles the cell in the knee joint of the embryo (Fig. 1, *a*). *b*. Cell more degenerate. *c*. Homogeneous material evidently representing fluid in the cavity.

connective-tissue cells which, in the stratum synoviale, are well supplied with capillaries.

In 1924, the writer pointed out the similarity between the early stages of the cystic bursal hygroma and the formation of bone as it could be seen in a villus taken from the synovial membrane of the elbow joint in a case of osteochondromatosis*. The villus (Fig. 11) consists of relatively undifferentiated connective tissue in the vascular portion. Where the capillaries are less numerous, it can be seen that there is an increased amount of intercellular substance which is fibrillar in nature and which is comparable to the fibrillated exoplasm in the development of cartilage and to the fibrillary intercellular structures in the development of cystic hygromas. Figure 12 is a high-power magnification of a portion of such a villus as the one shown in Figure 11. In Figure 12, *a* it may be seen that the cell has become surrounded by the matrix of bone. The spiny contour of the cell space identifies it as a lacuna of the bone, with its bone cell. The matrix, in this case, took an eosinophilic stain in contradistinction to the basophilic-staining properties of the cartilage matrix shown in Figure 10, *x*.

In summarizing the similarity which I wish to establish, I shall point out in each of the three processes (development of bursal hygromas, development of cartilage in synovial chondromatosis, and development of bone in synovial osteochondromatosis): (1) that there was preliminary prolifera-

*This was Case 14 of the series reported in 1924 in an article on synovial osteochondromatosis.[20]

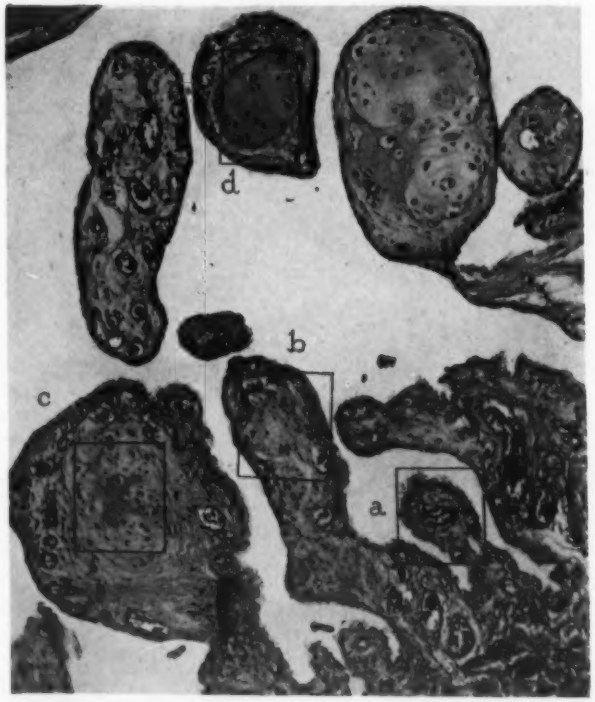

FIG. 6

Section of synovial membrane showing succeeding stages in the development of cartilage. Rectangles of the section designated *a*, *b*, *c*, and *d* are shown more highly magnified in Figs. 7 to 10.

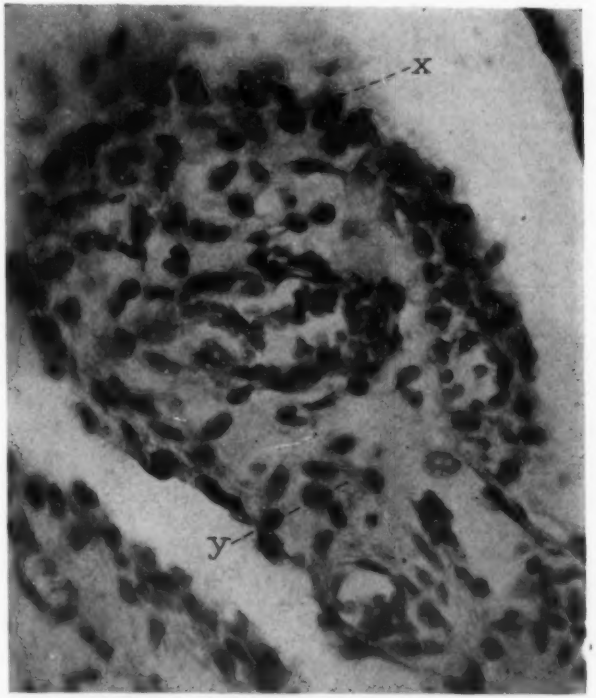

FIG. 7

Normal villus (Rectangle *a*, Fig. 6). Superficial cells of villus at *x* are similar to deep cells, at *y*, but deeper cells are more stellate, with nuclei more widely spaced.

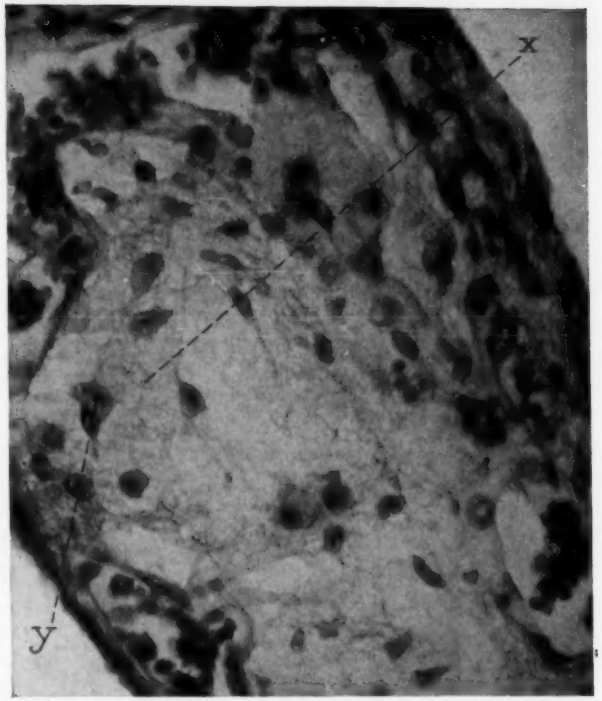

FIG. 8

Another villus (Rectangle *b*, Fig. 6). Fibrillated exoplasm at *x*; vacuolated endoplasm at *y*.

FIG. 9

Center of another villus (Rectangle *c*, Fig. 6). Fibrillated exoplasm at *x;* hyaline substance having replaced fibrillated structure at *y;* cartilage cell in cell space at *z*.

tion of undifferentiated connective-tissue cells well supplied with capillaries; (2) that these undifferentiated connective-tissue cells gradually became more widely spaced, and became separated by an avascular fibrillated structure or exoplasm; (3) that in the bursal hygroma the fibrillated exoplasm became replaced by a liquid matrix; (4) that in the case of the synovial chondroma the fibrillated exoplasm became replaced by the solid matrix of cartilage, and (5) that in the case of the synovial osteoma the fibrillated exoplasm became replaced by the solid matrix of bone. Little was the finding of such a relationship anticipated when this study was started.

FIG. 10

Center of another villus (Rectangle *d*, Fig. 6). Hyaline matrix of cartilage at *x;* well differentiated cartilage cells in cell space at *y;* large vacuoles in endoplasm of cartilage at *z*.

Noting the structural similarities described, I turned to the known facts of physiologic chemistry to see if the relationship extended into the field of chemistry. With the present state of knowledge of the organic chemistry of the tissues and fluids making up the bursal hygromas, one cannot draw definite conclusions. However, known facts in chemistry, combined with what may be seen in a study of the gross and microscopic appearances of the pathologic material at hand, strongly suggest certain possibilities which further research is likely to support. It is known from study of embryology that the mother tissue, from which cartilage, bone and bursal cavities (including joint cavities) develop, is an embryonic connective tissue, together with the fluids in which this tissue is bathed. It is known that before any of these structures form, a multitude of intercellular fibrils develop in the embryonic connective tissue with a morphology similar to the bundles of collagen seen in a more differentiated form in white fibrous connective tissue. The chemical composition of this connective tissue with the intercellular fibrillae is not known, but it is likely that it compares closely in composition, qualitatively if not quantitatively,

FIG. 11

Section of villus of synovial membrane in a case of osteochondromatosis of the elbow joint (magnified). *a*. Villus. *b*. Membrane lining villus. *c*. Particle of bone.

with that of white fibrous connective tissue. Mathews stated that white fibrous connective tissue (using the Achilles tendon of an ox for analysis) consists, exclusive of water, of collagen 85 per cent., mucoid 3.45 per cent., elactin 4.39 per cent., besides small quantities of fat, albumin, globulin, inorganic salts 1.26 per cent., and so forth. He also stated that the greater proportion of the organic matrix of cartilage is collagen. Mörner found that the organic matrix of cartilage yielded, on decomposition, besides collagen, a mucoid substance, termed chondromucoid, chondrotic acid (which is a decomposition product of chondromucoid), inorganic salts, and a very small proportion of an albuminoid. Mathews found that this chondromucoid is in all respects like the mucoid isolated from tendons. It is found that the organic matrix of bone is very much like the organic matrix of cartilage. Collagen forms the greater part of the matrix of the bone as it does the matrix of cartilage and of white fibrous connective tissue. There is mucoid present, termed osseomucoid, which on analysis yields practically the same proportion of carbon, hydrogen, nitrogen, sulphur and oxygen as chondromucoid and tendomucoid. Albuminoid, also present in very small amounts, is almost identical with the chondroalbuminoid. Thus, the greater part of the organic matrix of cartilage and bone consists of collagen and mucoid, and embryologically both tissues are derived from connective tissue, together with the fluid in which the tissue is bathed.

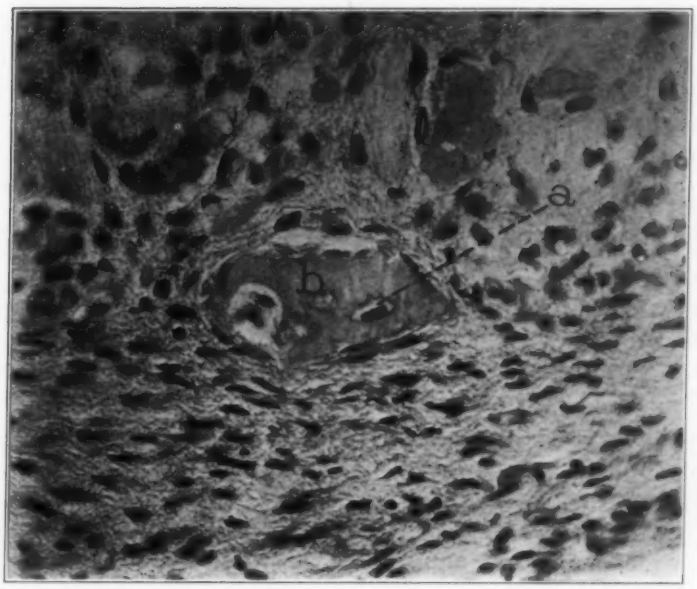

FIG. 12

Area in villus similar to one shown in Fig. 11, showing early stage in formation of bone (× 330). *a*. Bone cell in stellate lacuna. *b*. Eosinophilic matrix of bone.

This brings up the question of composition of the fluid contained in the cysts of bursal hygromas, the embryologic development of which is so similar to that of cartilage and bone. It is regretted that the preserved specimens do not furnish the most suitable material for the chemical investigations necessary; however, the studies, carried as far as possible with the material at hand, together with other known facts, suggested probabilities worth mentioning.

Analysis of the fluid aspirated from the bursae in Case 1 was made for percentages of water, total solids, inorganic salts, and organic material. Of course analysis of the organic constituents would be most valuable information, but the quantity of fluid obtained was not great enough to carry this out.

The amounts of fluid available were not sufficient for complete analysis. However, there is good evidence in the following data to show that there was considerable mucin present. First, when the fluid about the specimen was examined it was found to be ropy; that is, it threaded out like mucin. (The specimen had been preserved in formalin.) Second, when some of this fluid from the specimen (mixed with formalin as it was) was treated with hydrochloric acid, a copious white precipitate separated out, and this precipitate then redissolved in an excess of hydrochloric acid. (This is characteristic of mucin.) Third, a smear of this fluid, when stained with hematoxylin and eosin, took the basic stain decidedly as does mucin. Mathews stated that the mucins are conjugated proteins belong-

ing to the glycoproteins. Mucin from epithelial tissue differs slightly from mucin derived from connective tissue, so the term mucoid has been reserved to denote connective-tissue mucin in distinction from the ordinary mucin derived from epithelium. Mucin is related to cartilage through the mucoids. The mucoid of tendon contains chondroitic acid, as does cartilage which contains chondromucoid. Analysis indicates that osseomucoid, or the mucoid from the organic matrix of bone, is identical with chondromucoid; the elements carbon, hydrogen, nitrogen, sulphur, and oxygen have been found in practically the same proportion in each of the two types of mucoid. It is likely that the mucin or mucoid found in this cystic hygroma, which is a connective-tissue mucin, also contained this chondroitic acid as does tendon mucoid. This would relate the mucoid of the cystic hygroma to the organic matrix of bone and of cartilage and would substantiate the microscopic data, which indicate similarity in the organic matrix of bone, cartilage, and the fluid of cystic hygromas.

Not only is there a connective-tissue mucin or mucoid in connective tissue, cartilage, and bone, but, as Mathews said, the greater proportion of the organic matrix of cartilage and bone, as well as of white connective tissue, is composed of collagen. I have no information at hand to tell me if the fluid of bursal hygromas also contained collagen, but the gelatinous consistence of the contents of these cysts suggests that it did (Collagen, if heated with water, yields gelatin). Thus, definite morphologic and embryologic data, with suggestive chemical data, are afforded to support the view that this bursal hygroma is similar in certain respects to cartilaginous and osseous bodies which are formed from the synovial connective tissue of bursae. When a cartilaginous or osseous body is formed, the solid matrix causes the body to protrude into the bursa (or joint), whereas in the case of the cystic hygroma, a liquid matrix forms which results in a cyst instead of a solid body. The problem of what causes similar undifferentiated connective-tissue cells to form such different structures is yet to be solved. As Robertson suggested, it is probably some variation in the environmental conditions about these cells which determines whether cartilage, bone, or fluid is to be formed, rather than an inherent difference in the original connective-tissue cells themselves.

Thus far, in the study of the pathologic material, the early or embryologic kind, or stage, of bursal hygromas, classified as Type 1, has been considered. A case is described below which illustrates the intermediate, Type 2.

Hygromas of Type 2 (*Table I*). In Type 2 are included the cases in which there was evidence of active proliferation of connective tissue, with signs of liquefaction, and in which the proliferated connective issue was more differentiated than the mesenchymal type of connective tissue found in the case described as an example of Type 1. Also, in this type, the liquefaction evidently was not so widespread, and apparently was not progressing so rapidly as in the cases in Type 1. In other words, more differentiation had taken place in the cases of Type 2.

Case 2 (Case 9 of the series). The patient was a male student, aged twenty-one years, who came to the clinic February 19, 1913, complaining of a mass in the region of the left prepatellar bursa. The only history that he gave was that a few days before he had had a "cold", that he had walked rapidly, and, on the following day, had noticed the lump. The history probably had little to do with the mass, for the thick walls shown in the photograph of the gross specimen indicated changes that could hardly have come about in the short time mentioned by the patient. Pain or disability had not occurred.

On examination, the prepatellar bursa was soft, and apparently contained fluid. Slight local heat and redness were present. Motion of the knees was normal. Analysis of urine gave negative results aside from disclosing a faint trace of albumin.

April 1, 1913, the mass was excised under ether anaesthesia. The operative wound healed without trouble, and May 10 the patient was dismissed.

Gross examination of the specimen removed at operation showed it to be a biscuit-shaped structure about four centimeters in diameter and about one and five-tenths centimeters thick. There was a cystic cavity in the center (Fig. 13) which contained a sponge-like mesh of fibers that stretched across the cavity and covered most of the surface of the wall. At the time of operation, the surgeon noted that the cavity contained brown fluid. Where the wall was exposed, it was seen to have brownish nodules on a gray background. The wall varied from one to five millimeters in thickness.

Microscopic examination (Fig. 14) showed two main strata in the wall, an external and an internal. The external stratum was composed principally of moderately loose, white, fibrous connective tissue, including vascular fat lobules. Some of the fat lobules showed signs of atrophy of the fat, with proliferation of young connective tissue. The internal stratum was found to be composed of connective tissue, evidently proliferating, rich in capillaries (Fig. 14, *a*). The nuclei here were closely spaced, were elongated, contained a fair amount of chromatin, which was granular, and at times were grouped in one or several main clumps. This connective tissue was more differentiated than some of the embryonic type of tissue found in the first case. Toward the center of the cavity (Fig. 14, *b*), there were found connective-tissue cells, with nuclei farther apart and with a greater quantity of collagen fibers between the cells. The nuclei showed signs of necrosis, such as karyolysis and pyknosis. Further disintegration was found in another region (Fig. 14, *c*). The nuclei were even more necrotic and the intercellular bundles took a more intense eosinophilic stain. These bundles merged directly into the strands found in the center of the cavity and represented the structure that Langemak, and Neumann before him, called "fibrinoid". Langemak considered this condition to be an intermediate stage between the connective tissue and the liquefied product in the cystic cavity. In some places the type of connective-tissue change approached the appearance of the less differentiated form seen in this case. It was noticeable that there was much extravasation of blood in the zone of disintegrating connective tissue.

FIG. 13
Cystic mass removed from left prepatellar region in Case 2 (Case 9 of series). *a*. Spongy network in center.

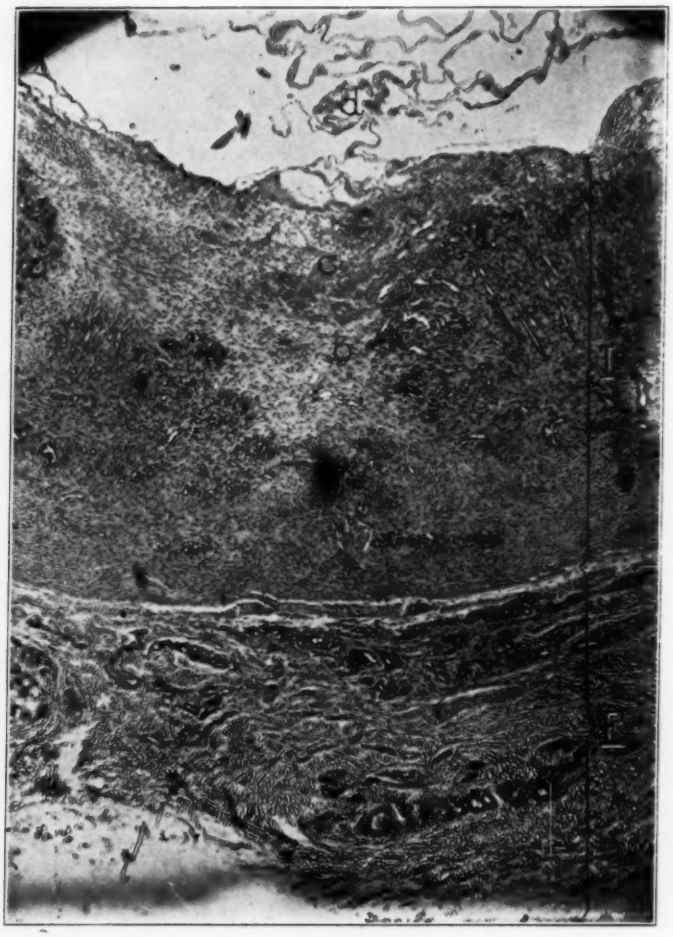

FIG. 14

Section of wall of cyst shown in Fig. 13 (× 30). *E*. External stratum of wall, consisting of moderately loose connective tissue with vascular fat lobules. *I*. Internal stratum, consisting of vascular, cellular connective tissue, evidently proliferating, with necrotic tissue bounding the cavity. *a*. Area of cellular, vascular connective tissue. *b*. Area showing signs of necrosis. *c*. Area showing more marked necrosis. *d*. Strands of fibrinoid tissue in cavity of cyst.

The central cavity contained, besides, the strands of spongy fibers which microscopic examination showed to be the fibrinoid of Neumann, the brown liquid, which was evidently the end product of disintegration.

In general, in this case (Case 2) there were more changes indicating differentiation than there were in Case 1.

Hygromas of Type 3 (Table I). It was stated, when the classification was given, that this group of hygromas contained dissimilar end products, probably depending on the environmental conditions at hand. The first subtype of Type 3 includes the necrotic hygromas. Here the connective tissue had become differentiated previously, but at the time of operation proliferation of connective tissue was not in progress. The main picture was that of disintegration. Hence subtype *a*, under Type 3, includes cases showing absence of proliferation, with liquefaction evidently in progress. From a number of cases, the following has been chosen to represent this subtype.

Case 3 (Case 19 of the series). The patient was a laborer in a flour mill and at the age of fifty years came to The Mayo Clinic (March 23, 1915) because of a mass in the right prepatellar bursa. The tumor was of ten years' duration and had been slowly en-

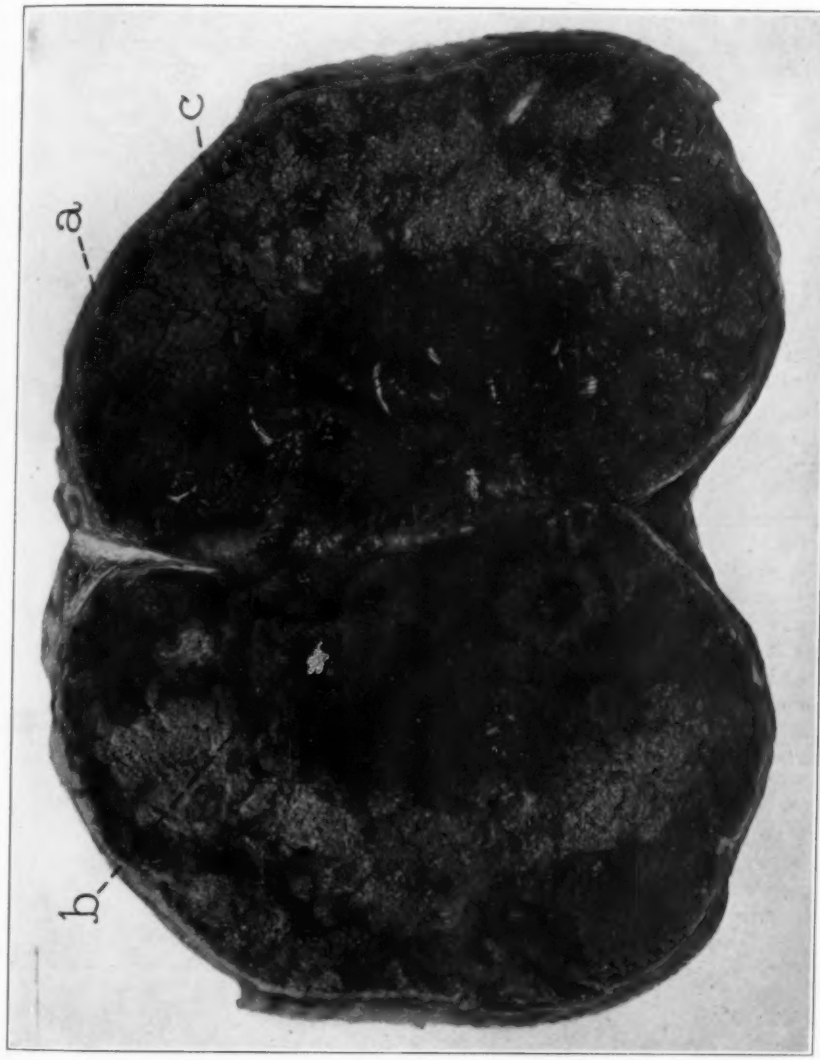

FIG. 16

Appearance of the cyst shown in Fig. 15. *a*. Tough fibrous capsule. *b*. Spongy "fibrinoid" in cavity. *c*. Fluid.

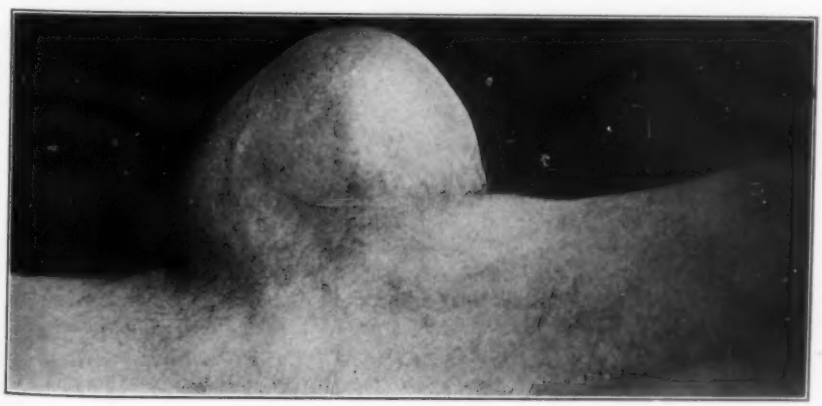

FIG. 15

Tumor in right prepatellar region in Case 3 (Case 19 of series).

larging during the previous winter. The patient complained only of an occasional sharp, shooting pain in the skin about the lump. His general health had been good and he had worked daily. He recalled a time, ten or eleven years previously, when the knee was very much swollen and afterward did not return to normal size. Evidently, in speaking of the knee, the patient referred to the prepatellar region. He termed the original trouble rheumatism. When the knee was so swollen, ten or eleven years previously, he had been working in a lumber yard and had had to use the knee a great deal.

The tumor in the right prepatellar region was described as being the size of a grapefruit (Fig. 15). The right thigh was two and five-tenths centimeters less in circumference than the left thigh. There was full motion of the right knee, without pain. There was some redness over the surface of the skin, which the examiner thought was due to irritation. The mass seemed cystic in the center.

March 26, 1915, under general anaesthesia, the mass was excised, and the incision closed except for the places of egress of two rubber tissue drains. The surgeon noted that the mass was about fifteen centimeters in diameter. The patient was dismissed from the hospital April 10, on the sixteenth postoperative day. A letter received from him in January 1928 stated that he had not had a return of the condition nor had any other portion of his body been similarly affected. In answer to a leading question in regard to "rheumatism", he stated that he had been bothered at times by his back.

Gross examination of the specimen removed at operation (Fig. 16) showed that the mass consisted of a tough capsule containing principally a brown, friable, spongy material which was loosely attached to the capsule. Microscopic examination revealed much more definitely the nature of the mass. Figure 17 represents a section through the cystic capsule, with some of the attached spongy content. Externally (Fig. 17, *a*) there was a layer of loosely arranged, white, fibrous connective tissue, containing a few arterioles and venules, some capillaries, and in one region of this outer stratum, a partly disintegrated fat lobule was found. The rather sparsely situated vessels found in this stratum contained blood. The nuclei of the connective-tissue cells of this outer stratum showed signs of necrosis, such as karyolysis and pyknosis. With van Gieson's stain, which ordinarily stains white connective tissue fibers red, this outer stratum was seen to be mostly of a yellowish-brown color, although a few flecks of red were present. The outer layer merged rather sharply into the next stratum (Fig. 17, *b*) which could be seen to consist of bundles of white fibrous connective tissue, the nuclei of which were even more necrotic than in the external layer. Here the nuclei were either entirely absent, or else they were pyknotic. Blood vessels penetrated this layer in a few places and were marked by perivascular accumulations of lymphocytes that were not thickly placed. The connective-tissue fibers of this layer were in definite, compact bundles, and stained yellowish brown with van Gieson's stain; the red stain ordinarily taken by connective-tissue bundles was not seen. This stratum (Fig. 17, *b*) merged gradually into a lighter staining, more homogeneous stratum (Fig. 17, *c*). This stratum was avascular, the bundles of fibers noted in the previous stratum considered (Fig. 17, *b*) could hardly be made out, and even necrotic nuclei were hard to find. This stratum (Fig. 17, *c*) stained a lighter, brownish yellow with van Gieson's stain and merged gradually into the next stratum (Fig. 17, *d*), which could be seen to be made up of a meshwork of the yellowish-brown material containing, in places, a disintegrated, finely fibrous structure. The framework of this sponge-like structure was seen to resemble the structure of the necrotic wall, and clearly represented the material called fibrinoid by Neumann, Langemak, and other German observers. Between this spongy network of fibrinoid were found many necrotic erythrocytes and a few leucocytes that were mostly of the polymorphonuclear variety. There were also a few large, free, bladder-like cells which probably represented changed connective-tissue cells. A homogeneous matrix (Fig. 17, *f*), which stained less definitely eosinophilic than the fibrinoid, and which took the basic stain faintly, could be seen. This material gave every indication of being precipitated fluid content of the cyst. Some of the spongy, central material of this bursa was examined chemically and was found to contain fibrin.

Thus, this case illustrated a late stage of cystic hygroma, without evidence of even recent proliferation. The guess can be made that liquefaction was in progress at the time of operation, but liquefaction was

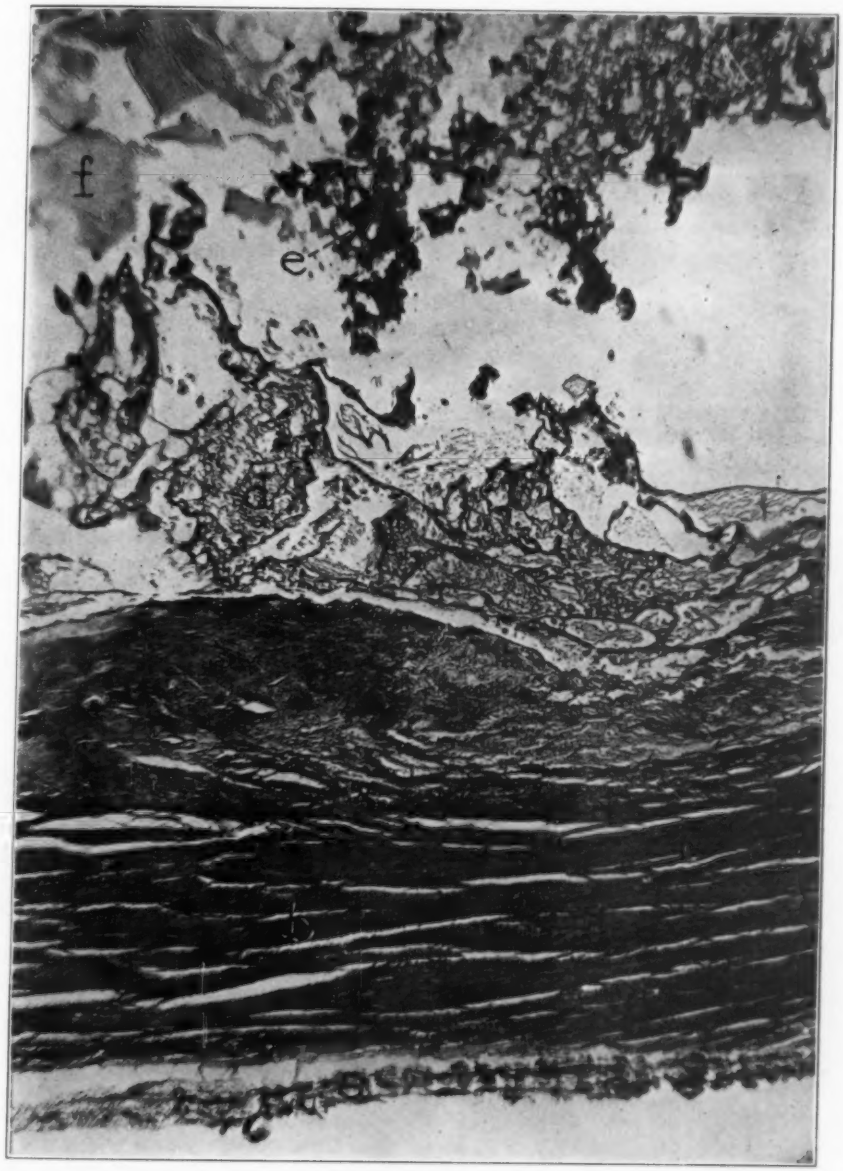

FIG. 17

Section of wall and content of cyst shown in Fig. 16 (× 24). *a*. External layer of loose connective tissue containing blood vessels. *b*. Necrotic, densely fibrous layer (stained brownish yellow by van Gieson's stain). *c*. Tissue more necrotic than that in layer *b*. Bundles as in layer *b* not found. *d*. Meshwork indicating further disintegration. *e*. Further disintegration indicated. *f*. Homogeneous material, stained faintly with hematoxylin, evidently indicating mucinous fluid.

obviously incomplete. Evidently the environmental conditions were not right for complete liquefaction. An adult type of connective tissue had been formed in the past and liquefaction evidently was not as rapid or as widespread as it was in Case 1, in which the embryonic connective tissue seemed to have undergone rapid liquefactive changes without very much differentiation of the connective-tissue cells.

Following the case just reported, in which necrotic changes were so much more in the ascendency than proliferative changes, I shall present two cases in which proliferative changes apparently had won out over the destructive and liquefactive changes. The first of these shows evidence of past liquefactive change, with present evidence of proliferation; and, so far as may be judged in the second case of this group, a very evident destructive liquefactive process never was present. The record and considerations of the first of these two cases follow.

Case 4 (Case 7 of the series). June 13, 1908, a man, aged forty-seven years, came to the clinic complaining of a swelling over his right knee-cap. Nine months previously, he had severely bumped his right knee-cap and it had been a little sore ever since. Three or four months previously a soft swelling had been noted. Apparently the mass contained fluid. There had not been any pain, but this knee had seemed weaker than the opposite one.

June 6, 1908, the right prepatellar bursa was excised (Fig. 18). None of the necrotic, sponge-like fibrinoid tissue could be found in this bursa. The most striking part of the picture was the cords of tissue found stretching from one part of the wall to another (Fig. 18, *c*). They were the structures termed *Balken* by the German authors, and there is no English word that may be accurately applied to the formation. They are trabeculae which remain after liquefaction or destruction of surrounding tissue. In many other specimens, as well as this, these trabeculae suggested the appearance of the chordae tendineae of the heart. The main part of the wall was gray and smooth. On the wall were many tubercles which appeared to be of the same structure as the trabeculae, but which did not reach from wall to wall. The trabeculae, as well as these tubercles, often were marked by yellow nodules which were found, on microscopic examination, to be fat. A section was made of a tubercle and it was found to contain fat lobules, arterioles, and venules, suggesting that it was the remainder of preexisting tissue; however, instead of finding the surface necrotic, as were the tubercles (*Höcker*) described by Langemak, I found it to consist of a fairly well developed lining of mesothelial cells covering vascular connective tissue similar to that found in synovial villi of joints. A section of certain of the trabeculae showed that they consisted of fibrous connective tissue containing arterioles and venules, as well as capillaries. The structure of the tissue was similar to that found in the tubercles.

FIG. 18

Portion of wall of cyst in Case 4 (Case 7 of series). *a*. Light brown nodules or villi standing out from gray wall of cyst. *b*. Gray wall of cyst. *c*. Tissue trabeculae.

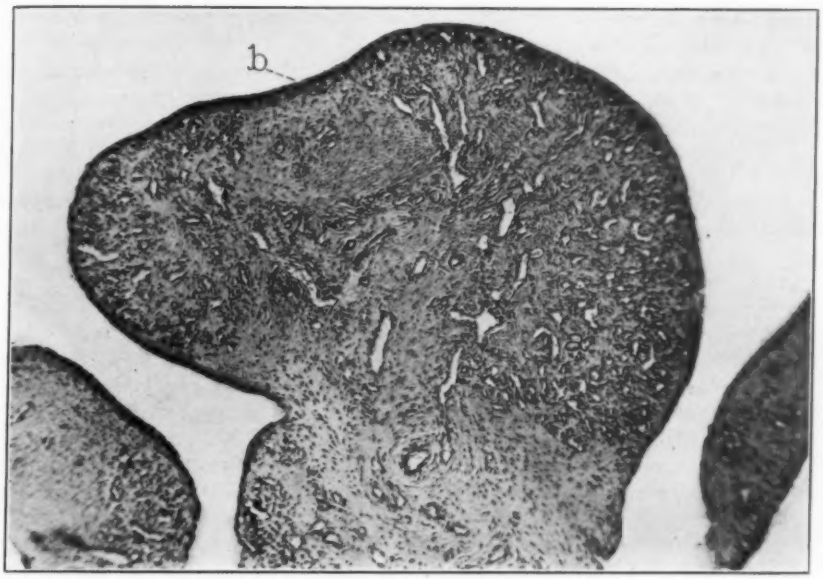

FIG. 19

Section of brown nodules at *a* in Fig. 18 (× 50). *a*. Cellular, vascular connective tissue, showing evidence of proliferation. *b*. Mesothelial covering of villus.

Besides the processes from the wall which have been described, there were many small, fern-like villi. These were found to be fibrous and avascular and covered by a fairly regular mesothelial lining.

Another type of nodule on the wall, which was identical with similar structures in a number of other cases, I consider important because Langemak has held that these hygromas never are proliferative. These nodules, or lumps, are characteristically light brown, in contrast to the usual gray wall (Fig. 18 *a*). Figure 19 represents a section taken through region *a* in Figure 18. It was found to consist of villi composed of vascular young connective tissue, and it was covered by a fairly well differentiated mesothelial lining. These growths lacked the fat lobules, larger arterioles, and venules which indicated the remains of original tissue such as were found in the other type of nodule of the wall (*Höcker*). Undoubtedly this represented proliferation.

Thus this case illustrated a late stage, or Type 3, with evidence of past, but not of present, destructive or liquefactive changes, and with evident proliferative changes.

The second case, which illustrates subtype *b* of Type 3, showed evidences of proliferation without signs of present or past destruction or liquefactive changes. The report, description, and consideration of the case follow:

Case 5 (Case 53 of the series). July 8, 1927, a man, aged twenty-one years, came to the clinic complaining of a ridge over the left patella. About October 1926, he had been in a runaway accident, had been thrown against a post, and had struck his left knee-cap severely. The knee had been stiff for two weeks. There had been slight swelling over the knee-cap. Following this, there had been soreness, which had prevented kneeling. Trauma had been followed by aching. In July 1927, he again had bumped the knee and it had begun to bother him again. He complained principally

of the ridge of tissue which rolled over his left patella and of a swelling in front of the patella which came after use.

Examination, July 8, 1927, revealed tenderness and hydrops in the region of the left prepatellar bursa. July 19, there was less swelling, but ridges on the patella were noticeable. July 20, under general anaesthesia, the left prepatellar bursa was excised.

Gross examination of the specimen removed at operation, and preserved in formalin, showed that the wall was tough,—about two to three millimeters thick. The wall was mostly gray, and was seen to be in folds, but it did not present trabeculae, nor any of the spongy fibrinoid tissue so commonly found in bursal cysts. On the gray wall, were seen brownish raised patches.

A section was taken through one of the brown patches on the wall of the cyst. Microscopic examination revealed that there were three main layers. Externally there was a layer of relatively loose connective tissue containing fat lobules, some of which showed evidence of proliferation of connective tissue, and atrophy of the fat cells. There were arterioles, venules, and capillaries, particularly in the region of the fat lobules. The intermediate layer was composed of dense connective tissue, with abundant white fibers and dark-staining, elongated nuclei. The intermediate layer was not particularly vascular, but here and there could be seen groups of capillaries. In places, this intermediate stratum reached to the inner surface of the cyst, without any other covering, but in places there were elevated patches containing many small capillaries. A portion of the intermediate stratum covered by the vascular connective tissue is shown in Figure 20. The vascular inner layer (Fig. 20, *a*) at least suggested, in appearance, the stratum synoviale of synovial membrane. The patches of vascular connective tissue seen at the surface bounding the cystic cavity, represented the raised brownish patches seen in the gross against the gray wall. The gray wall, seen in the gross, was made up of the areas in which the intermediate stratum bounded the cystic cavity without any attempt at forming a stratum synoviale (Fig. 20, *a*). Perivascular accumulations of lymphocytes were not found in any great number. It was noticeable that the patches of vascular connective tissue which simulated the stratum synoviale were placed over those parts of the intermediate stratum which were most vascular.

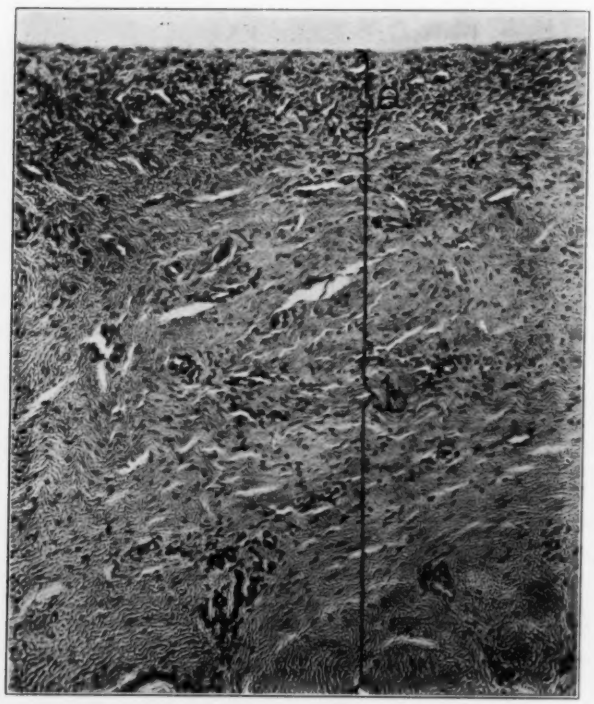

FIG. 20

Section of wall of bursa removed from left prepatellar region in Case 5 (Case 53 of series) (× 100). *a*. Stratum synoviale, consisting of vascular connective tissue with mesothelial covering. *b*. Portion of intermediate stratum of wall, consisting of more fibrous connective tissue, containing blood vessels here and there.

This case illustrated one of the late stages, or Type 3. There was evidence of

proliferation of connective tissue but no signs of destruction or liquefaction. I interpreted it either as the traumatic changes in a bursa which existed previously, or else as an example of the development of a partly differentiated synovial cavity in response to trauma. The presence of a capillary blood supply to the regions simulating the stratum synoviale indicated the importance of a vascular environment in the development of the picture presented.

Type 3, subtypes *a* and *b*, have been considered. Type 3, subtype *c*, is next in order. This subtype probably represents a late resting stage, for in this there was no evidence of proliferation nor active liquefaction. It is a rather common type of cystic hygroma, and consists of a fibrous capsule containing gelatinous, mucinous fluid. The walls of the cyst are gray, and the cavity does not contain spongy fibrinoid tissue.

Case 6 (Case 18 of the series). A man, aged forty-nine years, came to the clinic March 18, 1920, complaining of a pain and a mass on the mesial surface of his right knee. Seven years previously he first had noticed pain. About the same time he had noticed a small, hard mass, about the size of "half a cherry", that seemed fixed to the bone. The mass had remained about the same size for three or four years and then had begun to grow. Growth had been noted especially during the preceding six or seven months. The pain had been intermittent, coming at times without cause, but at other times an attack would be started by striking the right foot against something in a manner that would throw a strain on the internal lateral ligament of the knee joint. For four or five days at a time the pain would be severe, like a toothache, but for periods of from six to eight weeks there would be a dull ache. The history also included pain low in the back,

FIG. 21

Cyst removed from mesial aspect of right knee joint in Case 6 (Case 18 of series).

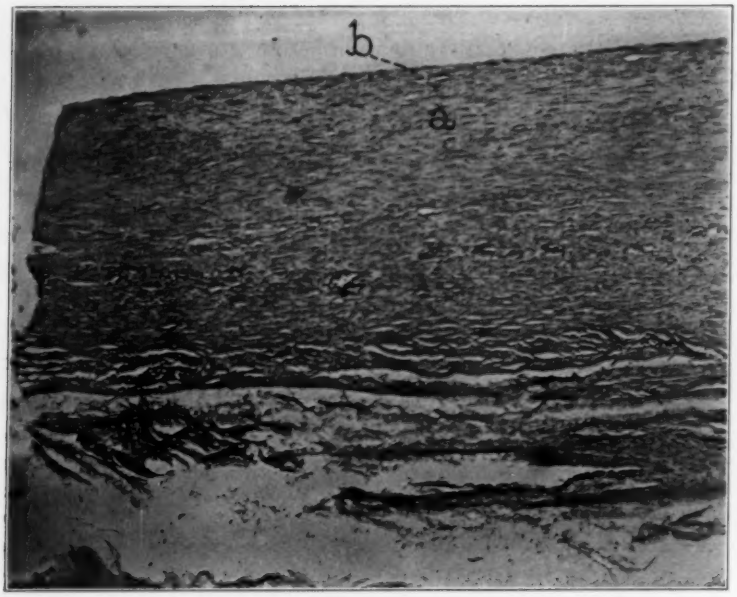

FIG. 22

Section of wall of cyst shown in Fig. 21 (× 75). *a*. Dense fibrous necrotic connective tissue. *b*. Smooth, necrotic, inner surface of wall of cyst.

which had been relieved by pelvic strapping, and for which a sacro-iliac belt had been provided. He had had an obstruction in the left nostril for which an operation had been done and he had been bothered, at times, by discharge of thick pus from the nostril.

Examination showed, on the mesial aspect of the right tibia, a fluctuating biscuit-shaped mass, which was rather fixed and moved more with the tibia than with the femur. Roentgenograms of the right knee did not give evidence of abnormality.

March 25, 1920, under ether anaesthesia, a cyst two and five-tenths centimeters long, two and twenty-five one-hundredths centimeters wide, one centimeter thick, and weighing fifty grams, was excised from the mesial aspect of the right knee joint. It was firmly attached to the capsule of the joint but did not communicate with the joint.

A letter received from the patient in January 1928, stated that he had not had recurrence of the trouble, that he had not been bothered by similar trouble in any other part of the body, and that he had not been troubled by rheumatism.

Figure 21 shows the cyst after removal of the fluid content. The cyst, which had been preserved in formalin, was not broken. When sectioned, it was found to contain semifluid mucoid material.

Microscopic examination of a section of the wall of the cyst (Fig. 22) showed it to consist of dense fibrous connective tissue which was vascular externally. The capillaries penetrated in a few places deep into the fibrous capsule, but the inner part was entirely without blood supply. The necrotic connective tissue at the inner surface, bounding the cystic cavity, formed a smooth margin. Material simulating fibrinoid was absent and the appearance was that of a late resting stage.

Hygromas of Type 4 (Table I). As indicated in the classification, Type 4 included combinations of the different types and subtypes. Usually the main pathologic picture was that of one type; however, at times the changes present in several parts of the same specimen illustrated different conditions

and necessitated the inclusion of mixed types. A case illustrating the mixed type will be presented briefly.

Case 7 (Case 43 of the series). The patient was a farmer, aged sixty-four years, who came to the clinic complaining of a mass in the left prepatellar region. Trauma was not mentioned, nor was the period of duration given. The Wassermann reaction of the blood was negative.

February 5, 1925, the mass was excised and was found to be seven and five-tenths centimeters in diameter. Figure 23 shows the appearance of the inner surface of the cyst. A large part of the wall was gray (Fig. 23, *a*). There was spongy fibrinoid tissue (Fig. 23, *b*), and tissue trabeculae (Fig. 23, *c*) could be seen. These data indicated degenerative changes classified as Type 3, subtype *a*. Here and there, projecting from the gray wall, were light brown tubercles. A section of one of these tubercles showed cellular, vascular, connective tissue with signs of recent proliferation, simulating very well the structure of the stratum synoviale. This part of the specimen could be classified only as an example of Type 3, subtype *b*. Hence, this was of a mixed type, grouped as Type 4 in the classification.

Comment: Only one case was found to represent Type 1. Five cases were classified under Type 2. Sixteen cases were classified under Type 3, subtype *a*. Five cases were classified under Type 3, subtype *b*. Fifteen cases were classified as Type 3, subtype *c*. Eleven cases were classified under Type 4; six of these were combinations of Types 3, *a* and 3, *b*; four were combinations of Types 3, *b* and 3, *c*, and one case was a combination of Types 2 and 3, *b*. Two cases could not be grouped, one because a recent injection of phenol had masked the picture and another because the bursa covering an exostosis had not been sufficiently preserved to enable a section to be made.

FIG. 23

Inner surface of cyst removed in Case 7 (Case 43 of series), illustrating mixed type. The gray wall (*a*), spongy network (*b*), and trabeculae (*c*), are evidences of destructive changes. Light brown tubercles projecting from wall (*d*), when examined microscopically, are found to be signs of proliferation of connective tissue.

Cases in which there was a definite history of some trauma were analyzed to see if any relation existed between the time which had elapsed since the trauma and the types in which the cases fell. In the one case in Type 1, there was a history of severe injuries eight months and one and a half months previous to operation. There were only two cases classified under Type 2 in which there was a history of definite, severe trauma. In each case the injury occurred six months previous to operation. Five traumatic cases were in Type 3, *a*; intervals between injury and operation varied from one to nine years, with an average interval of two and a half years. Three of the cases were in Type 3, *b*, with intervals between injury and operation which varied from nine months to five years. Four cases were of Type 3, *c*, with intervals of two and a half years to sixteen and a half years between injury and operation, averaging six and a half years. Several other cases belonged to the mixed types. The cases were rather few to serve as the basis of conclusions but, as far as I could interpret the meaning, they indicated that Type 1 and Type 2 were represented by recent injuries, that Types 3, *a* and 3, *c* were represented by old injuries and that Type 3, *b* was represented by cases presenting either recent or old injuries. One would expect to find cases of Types 1 and 2 representing recent injuries, for these types included the undifferentiated formation. It was to be expected that Type 3, *a* (the necrotic cyst) and Type 3, *c* (the resting cyst) would be represented by cases giving a history of injury long before. It could be understood how Type 3, *b* could be represented by cases with histories of either recent or old injury, because Type 3, *b* was illustrated by those bursae which had a stratum synoviale and this stratum synoviale may have been a normal part of the original bursa before the injury described as recent, or an old injury might possibly have been instrumental in starting those changes which later resulted in the formation of the stratum synoviale.

The development of rice bodies of different types was observed in several cases, and the pathologic material examined gave definite evidence in regard to the mode of formation of the rice bodies. The necrotic, fatty rice body will first be introduced for study by brief presentation of the following case:

Case 8 (Case 50 of this series). The patient was a woman, aged twenty years, who came to the clinic complaining of enlargement of the left prepatellar region, that had been present for about one and a half months. The cause of the condition was not known. It produced more than ordinary pain and disability.

November 5, 1926, a sac in the prepatellar region was excised. It was fatty, enclosing a cyst which measured one and five-tenths centimeters in diameter and which contained ten or fifteen rice bodies resembling grains of wheat or millet. One of these free bodies was sectioned (Fig. 24), as well as one body found attached to the wall of the cyst (Fig. 25). The central part of the body could be seen to be made up of necrotic fat. Surrounding this fat there was a fibrous layer which stained with eosin rather than with hematoxylin, and which became stained yellow by van Gieson's stain. It represented the tissue called fibrinoid. Surrounding the yellow fibrinoid tissue there was a thin, superficial fibrous layer which took the red stain by van Gieson's method. A few pyknotic nuclei could be made out near the surface. Undoubtedly the tissue surrounding

FIG. 24

Section of rice body in Case 8 (Case 50 of series) (×20). *a*. Necrotic fatty center. *b*. Necrotic fibrous outer layer.

FIG. 25.

Section of wall of cyst, with attached necrotic rice body which is similar to detached rice body of Fig. 24 (×20). *a*. Necrotic fatty center of rice body. *b*. Fat lobule in wall of cyst. *c*. Evidence of liquefaction in this region.

the fatty center was composed of the necrotic remains of fibrous connective tissue. Figure 25 illustrates a section of a body found attached to the wall of the cyst. In some of the sections, definite continuity of tissue determined that the body was actually attached and not merely in contact with the wall. This attached body was in all respects similar to the free body except for the attachment. Other fat bodies, or lobules, showing earlier stages of necrosis, were found embedded in the wall of the cyst (Fig. 25, *b*). Some of these fat lobules were avascular and necrotic, whereas others contained capillaries and were in a better state of preservation. The interlobular connective tissue was vascular in most places, but some avascular regions were found that showed definite evidences of liquefaction, such as disintegrated tissue with precipitated homogeneous material, having every appearance of precipitated or coagulated fluid. There was very little evidence of proliferation of connective tissue but there were definite signs of liquefaction in process; so this case was classified under Type 3, subtype *a*. From this case, it could be determined definitely that some rice bodies were formed from fat lobules, and it seemed reasonable to believe that these necrotic lobules were left by the disintegration and liquefaction of the intervening connective tissue. I believed it reasonable to conclude that these bodies were not necessarily thrown off from the wall of the cyst but that they represented rather the remains of tissue that originally composed the region later occupied by the content of the cyst. References in the literature to fatty rice bodies may be found in an article by Graser, quoted by Langemak.

The fibrinoid type of rice body will be illustrated by two cases. The data in the first of these two cases follow:

Case 9 (Case 51 of the series). The patient was a man, aged forty-one years, who came to the clinic complaining of a mass in the left prepatellar region (Fig. 26). The mass first had been noticed fourteen months previously. The cause was not known. There had been pain and disability, and, for the preceding two weeks, considerable local heat and swelling. There was also thickening in the region of the right prepatellar bursa.

March 9, 1926, the mass in the left prepatellar region was excised. It weighed two hundred and four grams, and, on gross inspection, was seen to be composed of a capsule two to four millimeters thick enclosing a cystic cavity seven centimeters long, six centimeters wide, and six centimeters thick. This cavity contained a large number of yellowish-gray (preserved in formalin) rice bodies. They resembled kernels of wheat more than rice. These rice bodies apparently were entangled in a spongy network of the same yellow gray. Where the walls of the cyst were exposed it, also, was yellowish gray (Fig. 27). A section was made of the wall of the cyst at a point where a rice body was attached. Microscopic examination of this section revealed that the rice body (Fig. 28, *a*) was composed principally of fibrinoid tissue. In certain regions (Fig. 28, *c*), it could be seen that the spongy spider-web mesh by which the body was surrounded consisted of small trabeculae of fibrinoid tissue between which were stretched very finely branched rough threads that apparently were left after partial liquefaction of the fibrinoid tissue. At least the fine threads could be followed directly into the fibrinoid masses, and morphologic structures could be found representing various stages between the solid masses and the loose meshwork of fine threads, which, with the narrow trabeculae of fibrinoid tissue, made up the spongy, spider-web-like mesh which surrounded the rice bodies. Suspended in the fine, thread-like mesh could be found the necrotic nuclei of fibroblasts, polymorphonuclear leucocytes, lymphocytes, and erythrocytes in various stages of necrosis. The thread-like mesh was so very fine that in places it was almost homogeneous and appeared to be precipitated fluid. The wall of the cyst (Fig. 28, *b*) was composed externally of vascular connective tissue. Deeper in the wall there was evidence of recent extravagant proliferation of fibroblasts, with many capillaries which contained blood cells. The blood cells in this deeper layer did not take the eosinophilic stain as well as the blood cells in the external layer, and the tissue was evidently

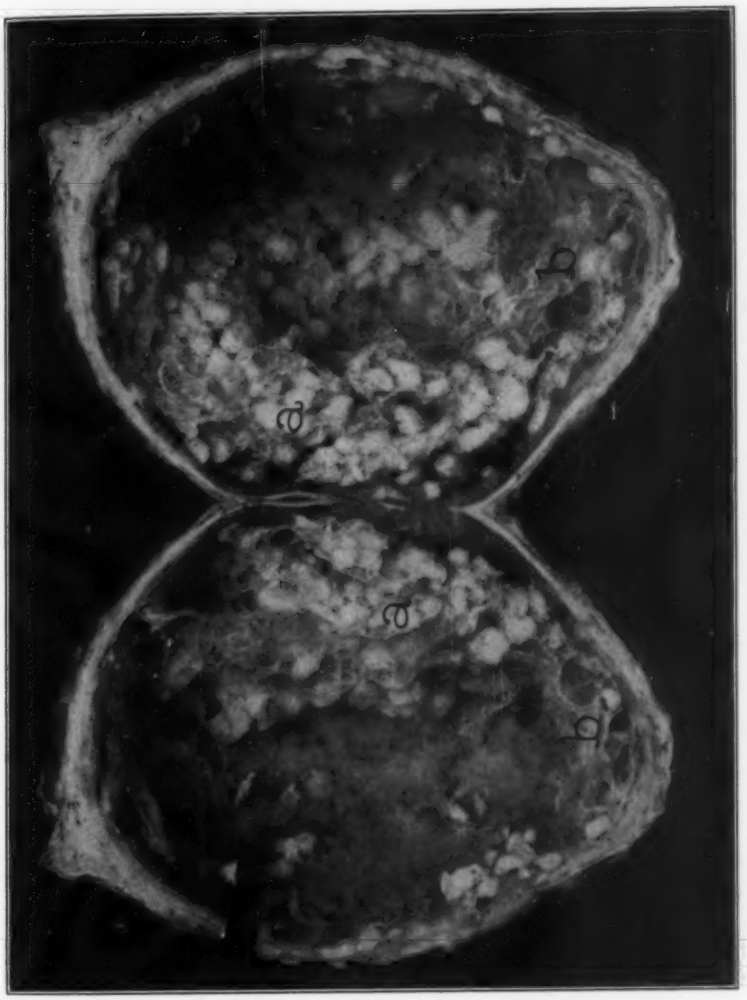

FIG. 27
Cyst excised in Case 9 (Case 51 of series). *a*. Rice bodies. *b*. Spongy network of fibrinoid tissue.

FIG. 26
Patient in Case 9 (Case 51 of series) showing mass in left prepatellar region.

necrotic, as shown by the karyolytic and pyknotic nuclei. The signs of necrosis were more marked deeper within the wall of the cyst. The case was classified as an example of Type 3, subtype *a*. These rice bodies had been formed by the process of disintegration which left portions of incompletely degenerated fibrinoid tissue. The bodies could well be termed fibrinoid rice bodies to distinguish them from the fatty rice bodies described. The impression was gained, from a study of the microscopic sections, that these bodies were formed in situ by destruction of intervening necrotic tissue rather than by being thrown off from the wall of the cyst.

Case 10 (Case 6 of the series). The patient was a housemaid, aged twenty-seven years, who came complaining of a mass in the left prepatellar region. There was no history of severe trauma aside from the kneeling incident to her occupation. Six months previously the region had been markedly swollen. The swelling had receded, leaving a small lump, which subsequently had enlarged. There was slight pain and slight disability.

February 21, 1919, the mass was excised. It was found, grossly, to be a very thickened sac containing rice bodies. The mass was biscuit-shaped, and the cavity was about two centimeters in diameter. The walls varied from three to seven millimeters and presented a gray smooth surface.

Microscopic examination showed vascular connective tissue externally, which merged, internally, rather abruptly into fibrous necrotic connective tissue, typified by the area in Figure 29, designated *a*. The inner part of the wall of the cyst was entirely avascular and very necrotic, as evidenced by the marked pyknosis, karyorrhexis, and karyolysis. This necrotic tissue presented areas showing many basophilic granules, indicating the presence of lime salts. Van Gieson's stain colored most of the external connective tissue red, but the deeper necrotic connective tissue was stained, mostly, a yellowish brown.

A section of a rice body (Fig. 30) resembled closely in morphology and staining reaction the area that is marked *a* in the section of the wall. It was reasonable, therefore, to conclude that this rice body was composed of necrotic connective tissue similar to that in the wall of the cyst. One can suppose that this rice body represented a portion of the original tissue which filled the space later occupied by the cystic cavity, or perhaps it was cast off from the wall as a necrotic fragment and attained its rounded form by being constantly moved about in the sac-like cavity. The case was classified under Type 3, subtype *a*. Thus the observation in regard to the development of rice bodies checked closely with the ideas which were expressed by Langemak.

Case 11 (Case 16 of the series). The patient was a boy, aged seven years, who came because of bilateral congenital club-foot. In the course of a corrective operation the bursa over the bearing surface of the left club-foot was excised. This specimen furnished the material for study. Grossly, the sac was found to have relatively smooth, gray walls presenting some folds as well as tissue trabeculae (*Balken*) reaching from one part of the wall to another. One of these tissue trabeculae was sectioned at its juncture with the wall of the sac, and microscopic examination showed that the trabecula was composed of vascular and fibrous connective tissue presenting the same morphologic and staining properties as the tissue of the wall of the cyst. In particular, however, I wish to point out the fairly well differentiated stratum synoviale that lined the wall, as well as the tissue trabeculae stretching across the cavity. Figure 31 shows the vascular connective tissue of the stratum synoviale overlying the fibrous connective tissue of the deeper layer. Examination of certain areas of the lining of the bursa, with the high-power magnification of the microscope, showed that the covering, or mesothelial cells, approached very closely the appearance of epithelium.

This case was of interest because it illustrated a synovial cavity developed in response to the need of the organism in a region where normally a bursa does not exist.

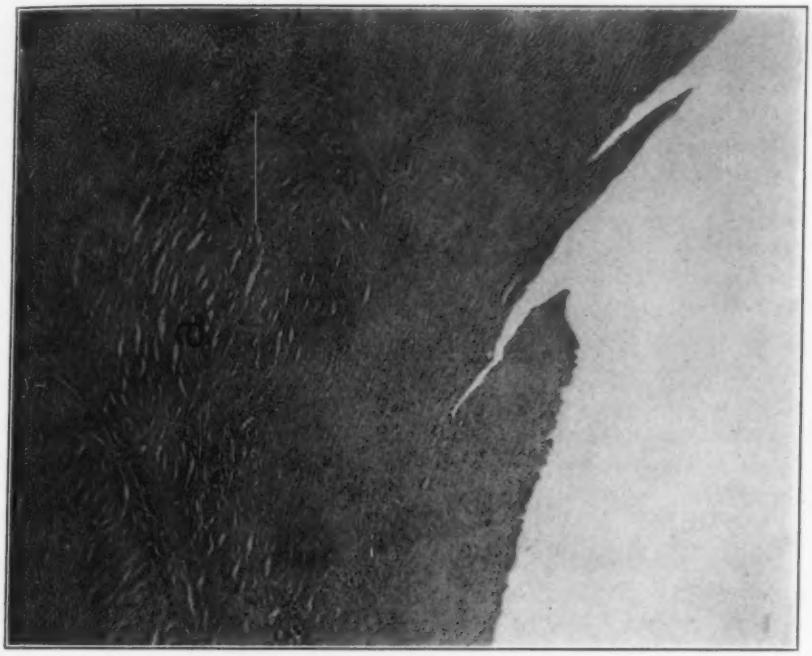

Fig. 29

Section of wall of cyst in Case 10 (Case 6 of series) (× 27). *a*. Fibrous necrotic connective tissue, with a structure similar to material making up free rice body shown next in Fig. 30.

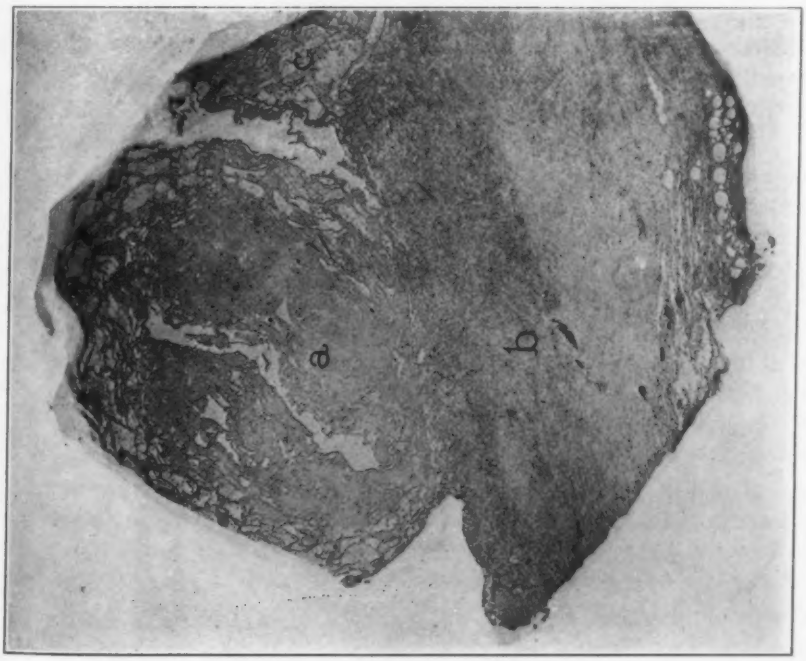

Fig. 28

Section through wall of cyst and attached body (× 15). *a*. Fibrinoid rice body; *b*. Wall of cyst. *c*. Spongy network of strands of fibrinoid tissue.

GENERAL COMMENT

Looking back on the material that has been presented and taking into account the information that has been gleaned from the literature, several points will be considered.

1. The first point has to do with treatment and results. Excision was carried out in each of the fifty-five cases studied. This does not mean that excision has been done as a routine at The Mayo Clinic, but that only cases in which pathologic material was available were included in this study. Subsequent information was obtained from twenty-seven patients. In two cases, the time which elapsed following excision was three months or less. In the other twenty-five cases, the time interval since excision varied from nine and a half months to fourteen years and three months; the average time interval was five years and eleven months. In none of the twenty-seven cases was recurrence reported, so it may be concluded that complete excision of cystic hygromas is likely to result in cure.

2. The second point has to do with the question of the presence of fibrin and fibrinoid tissue in the process of disintegration. In Case 1 (Fig. 2, *c*), there was a large number of fine strands, with a morphologic appearance suggesting fibrin. These fine strands stained a very lively blue with the phosphotungstic-acid method described by Mallory. Weigert's fibrin stain of this section showed no such blue strands as those shown by Mallory's phosphotungstic-acid stain. In my series, the Weigert stain was carried out on sections of twenty specimens, but did not show any fibrin-like strands. I believe the fault in showing the fibrin lay with the tissue stained, or else with the way the stain was carried out, for a control section of a lung with broncho-pneumonia, showing evident fibrinous exudate, was stained both by the Weigert method and by Mallory's phosphotungstic-acid stain. The phosphotungstic-acid stain showed well the fibrinous strands, but the Weigert stain showed it hardly at all. It is known that Weigert's stain is not very reliable in old tissue. Several sections of other bursae besides the tissue in Case 1 were stained by Mallory's phosphotungstic-acid stain, but fibrin was not found.

Added evidence of the presence of fibrin was obtained by chemical examination of the necrotic fibrinoid center of the cyst described in Case 3 (Figs. 16 and 17). Qualitative analysis showed that this necrotic material contained fibrin. Virchow, in supporting his teaching concerning tissue fibrin, gave as an example this change, illustrated by the process observed in bursae. Schuchardt, in 1890, in describing the structures in a hygroma, said that the thick, indurated wall was covered by a layer similar to fibrin. In describing a section stained by Weigert's method he wrote: "On the inner surface of the sac, rather sharply separated from the connective tissue, still inseparably connected with it, there is found a thick layer which partly consists of an irregular network of band-like, straight or undulating, shining, homogeneous trabeculae and partly of a fine network of thread-like fibrin with a few leucocytes. The latter (the fibrin) lies mostly in the

FIG. 31

Section of wall of bursa in Case 11 (Case 16 of series) (× 100). *a*. Vascular connective tissue, representing stratum synoviale. *b*. Fibrous connective tissue layer of wall of cyst.

FIG. 30

Section of free rice body found in cavity of cyst in Case 10 (Case 6 of series) (× 40).

spaces formed by the coarser trabeculae. . . The coarse trabeculae and the fine fibrin net often pass over directly into one another . . . The homogeneous trabeculae do not stain with Weigert's method . . . One encounters trabeculae in whose centers single wavy fibers stain a lively blue or trabeculae that show blue fibers in the periphery. Other trabeculae are pierced and surrounded by a perfect meshwork resembling the fibrin net of fine lively blue threads." In his description of the process, in speaking of the proliferation of connective tissue and the subsequent change, he said: "With this new formation of tissue there is associated soon a secretion of fibrin, partly in the changed tissue cells, partly between them—at any rate, primarily the fibrin is formed in the midst of the tissue and not on the free surface of a cavity". Mention has been made of the substance termed fibrinoid by Neumann, Langemak, and others. Langemak spoke as follows regarding fibrinoid, calling it "a mass similar to fibrin, which, as Neumann points out, is not an exudate but a degenerative product of a connective tissue, whose fibers by disappearance of cells become changed to a substance similar to or identical with blood fibrin".

Judging from the finding of fibrin chemically in the necrotic center of a bursa in Case 3, and from the morphologic and staining reactions of certain portions of sections in Case 1, I believe it reasonable to conclude that formation of fibrin plays some part in the development of at least certain cystic hygromas. However, I believe with Robertson that it is not wise to conclude that the connective tissue, of and by itself, changes to an intermediate substance, fibrin or fibrinoid, and then to the liquefied content of the cyst. The tissue fluids must be taken into account and consideration must be paid to the substance unseen, as well as to those made visible by staining. The tissue in question is not dry, and therefore the tissue fluids must play a part in the changes. At any rate, it can be concluded that the connective tissue becomes replaced by a colloid liquid mass. Probably this takes place by the influence of environment, important in which is the loss of capillary blood supply, the presence of tissue fluids, and chemical changes far from well understood. The result is morphologic changes shown by microscopic sections. It is reasonable to suppose that this colloid, liquid mass does not represent a pure or unvarying chemical substance but a varying mixture of the products of disintegration of cells. Robertson has called attention to the process of absorption which probably takes place. The substances composed of the larger molecules, such as the colloids, are less readily absorbed and hence are more likely to be left behind in the cavity of the cyst.

3. The third point to which attention will be directed has to do with the question as to whether the liquid content of cystic hygromas is entirely degenerative in origin or at times is partly made up of a transudate. Langemak held that the hygromas represented purely a degenerative process, and he found the tissue bounding the cavity always avascular.

I have found in numerous instances, illustrated in this report by Case 4 (Fig. 19), that the wall of the hygroma may have vascular processes pro-

jecting into the cavity. I cannot help believing that fluids from these capillaries would reach the cavity of the cyst.

4. The fourth point to be considered in retrospect is the question of etiology. Trauma is the most obvious factor in the development of cystic hygromas, as indicated by the data in the fifty-five cases studied (page 51). Males in the active period of adult life predominated and a large percentage of the patients were laborers and those who were subjected to rather severe bumps and bruises as well as to long continued trauma of a more moderate degree, as in the cases of the prepatellar hygromas of the nuns, the housemaids, and the housewives. In nineteen of the fifty-five cases the development of the hygroma followed severe trauma, and in eleven of the fifty-five cases there was a history of long continued moderate trauma preceding the formation of the cyst.

The question of infection as an etiologic factor comes next for consideration. Microscopic examination revealed many perivascular accumulations of lymphocytes, but these could be interpreted to be a reaction to traumatic inflammation as well as to infectious inflammation. At least, polymorphonuclear leucocytes were relatively absent. The finding of fibrin might be interpreted by some to indicate infectious inflammation should the fibrin be considered to be of the nature of a fibrinous exudate. The presence of fibrin does not always mean the presence of an inflammatory exudate, because fibrin forms an important part of every fresh blood clot. The appearance of fibrin in tissue undergoing destruction is not strange if the theory of Hertzfeld and Klinger, which is spoken of favorably by Wells, is accepted. Hertzfeld and Klinger put forth the idea that blood proteins are a continuous series of disintegration products of tissue proteins, of which the first step, fibrinogen, is the least changed. Wells noted that this theory accounts well for the increase in content of fibrinogen, with injury of tissue, as well as the spontaneous coagulation of injured tissues. If fibrinogen, which, on coagulation, forms fibrin, is an early product of disintegration of tissue protein, it is not strange that fibrin is found in the early stages of disintegration of tissue in the formation of a bursal hygroma (Case 1). The redness and local heat that often are noted in the skin over a bursal hygroma often have been interpreted as signs of inflammation; however, Langemak has pointed out that such hyperaemia disappears after twenty-four hours' application of hot packs or ice. He quoted Virchow as saying that such conditions follow mechanical insult to the tissues. Langemak was very decided in considering the fibrin or fibrinoid tissue not to be inflammatory but degenerative in origin.

Henderson, in discussing Earl's paper, stated that for years cultures of numerous bursae had been taken at The Mayo Clinic, and the negative results led him to believe that the cause was irritation and not infection.

In reviewing the records of the fifty-five patients whose cases were studied, one cannot help noticing the frequent complaint of rheumatism. The fifty-five cases include ten cases in which the rheumatic complaints were slight; seven in which they were moderate, and one in which they were

severe. Even though this incidence of rheumatic conditions is probably above the frequency of occurrence in an average group of persons, it is not possible to establish an etiologic relationship without further evidence. It may be that a patient with a reticulo-endothelial system subject to rheumatic changes, may also present connective tissue which is unusually suitable for the development of these cystic hygromas. However, this is a far-fetched guess. To my mind one of the strongest arguments against infection being the cause is to be found in the fact that the bursal hygromas follow so closely the embryologic method of development of bursal cavities.

Hence trauma, both acute and long continued, plays a significant part in the etiology, whereas infection has a doubtful place.

5. Following the consideration of the etiology, comes naturally the question of the classification of the process being studied. In trying to orient oneself in regard to cystic hygromas, it is well to stop and consider a few similar pathologic phenomena. It is likely that cystic hygromas are similar in their development to the carpal ganglions. Kaufmann, who examined many cases in the early stages, obtained the impression that the analogy between hygromas and ganglions held. Certainly the descriptions of Ledderhose, Ritschl, and Thorn, in telling of the pathologic development of ganglions, compare closely with the pathologic pictures in the development of bursal hygromas presented here. I judge from MacKee and Andrews' description of conditions in synovial cutaneous lesions that the synovial cutaneous lesions are similar to the cystic hygromas. Evidently bursal hygromas, including the accidental or occupational bursae, such as those on club-feet and miner's elbows, together with carpal ganglions and the synovial lesions of the fingers, are variations of the same fundamental process.

A plausible way to explain the preliminary proliferation of connective tissue is to consider it a reaction to irritation. This is in some degree to be understood when it is realized that continued irritation of a bone will cause exostosis, as, for instance, the evident bony proliferation on the head of the first metatarsal bone in a bunion. The hyperkeratosis, resulting from the irritation of the skin in the formation of calluses, is also a case in point. The degeneration and liquefaction may be considered a reaction of the tissue to the loss of capillary blood supply. What causes the cutting off of blood supply I do not know. Mucin-containing cysts occur elsewhere in the body as a result of proliferation followed by disintegration, for instance the mucinous cysts found in degenerating fibromyomas. In explaining my idea, I wish to call attention to the following facts and concepts:

In considering bursae in the widest sense, one finds examples, varying from mucous bursae, which Piersol said may be little more than exaggerated spaces between the layers of areolar tissue, to the more highly differentiated diarthrodial joints (which also represent bursae in the sense defined by Piersol). In the more highly differentiated bursae it has been indicated that there is a stratum synoviale represented by vascular connective tissue bounding the bursal space. The stratum synoviale is best developed in the lining of the joints. In the stratum synoviale of joints particularly,

the superficial cells take on at times the morphologic appearance of epithelial cells, suggesting that the synovial membrane is a highly differentiated stratum. In reality, it is not so highly specialized and cannot in any way be compared, for instance, to the lining of the stomach, because Key has shown that when hemisynovectomy was done on the knee joints of rabbits, a new synovial membrane formed in situ from the denuded base with very little tendency for extension of growth from the remaining synovial membrane. He stated that the newly formed membrane could with difficulty be distinguished from the original. He concluded that synovial cells are connective-tissue cells slightly specialized by their situation on a free connective-tissue surface. This anatomic concept of bursae is necessary for an appreciation of the development of bursae.

It has been shown that in many cases the superficial bursae attain their identity as bursae only after birth. Bursae may develop even later in life when necessity demands. For instance, a bursa develops over the kyphos in Pott's disease (to which attention was called by Tubby) as well as in the formation of bunion, which is a matter of common knowledge.

It is a significant fact that striking similarity may be shown between the development of the cystic bursal hygromas in the early stages and the development of bursal cavities in the embryos.

In the description of the pathologic material, cases were presented representing variable degrees of perfection in the formation of bursal cavities. In Case 11, an example of club-foot bursa (Fig. 31), a fairly well differentiated bursa had been formed; in Case 4 (Figs. 18 and 19), a less perfectly differentiated bursa had been formed, but the vascular connective-tissue processes shown in Figure 19 certainly represented in a striking manner the structure of the stratum synoviale; and in other instances, such as Case 3 (Figs. 16 and 17), almost complete destruction had followed the proliferative stage and had resulted in a structure that lacked much in approaching the appearance of a normal bursa. Repeatedly, in the specimens, the conflict between proliferation and destruction was seen, and in cases in which a vascular supply appeared to give the proliferative changes the upper hand, there was a more normal attempt at formation of a bursa. However, when the capillary blood supply was cut off and destructive changes were in the ascendency, the cystic formation fell far short of the appearance of normal bursae. Between these two extremes was a series of intermediate stages in which a part of the wall of the cyst was entirely necrotic, whereas another region would show evidences of proliferation simulating the structure of the stratum synoviale.

I am led to conclude that in the development of cystic hygromas, similar conditions must be at work as obtain in the development of bursae in the embryo and young child, the condition being fulfilled in a varying degree of perfection, resulting in bursae of varying degrees of perfection. In the bizarre types of bursae, most likely, the proper environmental condition for the development of a normal bursa has not been at hand and certain of the developments have been overdone.

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A SIMPLIFIED METHOD FOR TIBIAL LENGTHENING*

BY J. WARREN WHITE, M.D., GREENVILLE, SOUTH CAROLINA

The problem of lengthening legs, revived and a practicable method devised by Abbott[1] of St. Louis, and more recently discussed by Carrell[2] of Dallas, has interested a great many surgeons doing bone and joint work. The mechanical difficulties in effecting the desired result have discouraged most of us. Relatively few surgeons have mechanics or brace-makers qualified to construct the most ingenious but complicated apparatus which was devised by Dr. Abbott. We have thought of this problem here at the Greenville Unit of the Shriners' Hospitals, and have finally worked out a way that we believe to be practicable, and which will give us the desired lengthening with materials that are conveniently at hand, and which do not require the services of an expert brace-maker.

It is not the purpose of this paper to discuss the value of increasing the length of an extremity, but simply, as the title indicates, to describe the method which we have recently come to use at the above mentioned institution, and which, since we have found to be very satisfactory, we believe may be more generally employed.

The technique is as follows:

After about a six-inch longitudinal incision is made in the middle third of the leg, just lateral to the crest of the tibia, but before the usual Z osteotomy is done, four holes, just large enough to allow the regular-sized seven-inch Steinmann pin to pass snugly through, are drilled through the shaft of the tibia in the sagittal plane of the body. Before these holes are drilled, the proposed osteotomy cut is carefully outlined on the exposed anterior surface of the tibia. One hole should be about one-half to three-quarters of an inch proximal to the upper horizontal stroke of the Z, another the same distance distal to the lower horizontal stroke of the Z, and the others, two to three inches proximal and distal to the first two respectively. These holes are made, not through the osteotomy incision, but through small longitudinal skin incisions properly located and sufficiently enlarged, so that when the pins are in place there will be no distortion of the surface of the skin. The purpose of drilling these holes before actually doing the osteotomy is obvious, as it would be much more difficult to drill the holes in proper relative position when the bone is in two pieces.

For convenience and appearance it is well to drill these holes so that their axes are in about the same plane. It is not necessary for them to be exactly placed as is the case with the apparatus already devised. In other words it is not necessary for the pins to fit the apparatus; the apparatus accommodates itself to the pins.

*From The Shriners' Hospitals for Crippled Children, Greenville, S. C., Unit.

Subsequently then to the drilling of these holes, the fibula is severed in the usual way at the same level, obliquely enough to allow a little overlapping when the desired lengthening is obtained. This can be done through the same incision as is used in approaching the tibia if the former is made about three-quarters of an inch lateral to its crest. Then the usual Z osteotomy of the tibia is effected where previously outlined on the tibial surface. It might be noted here that it is very important to be sure that the two ends of the fibula are thoroughly freed from each other, including the periosteum in order to be sure to avoid pulling the distal end of the fibula upwards away from the ankle joint. The fibula is osteotomized first, as we have found it more easily done before the tibia is severed. The chances of obtaining a more perfect long oblique osteotomy are better. These osteotomies are done with either the motor saw, or the osteotome; we have preferred the latter.

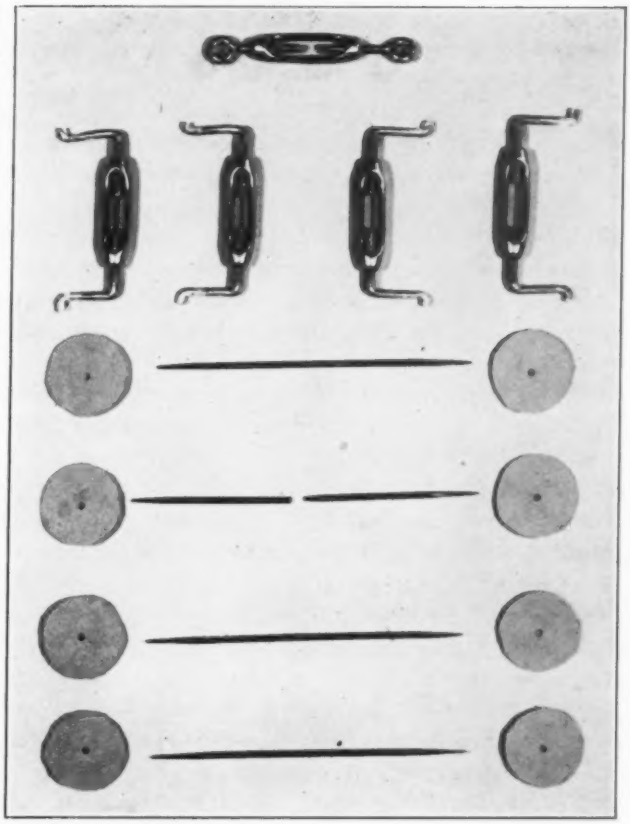

FIG. 1

Materials necessary in addition to a plaster-of-Paris leg cast. From above downward: a turnbuckle as purchased before the loops have been altered; four turnbuckles ready for insertion in the plaster except that they have not been completely screwed in; four jointed Steinmann pins, the second being unscrewed in the middle, at either end of which are the rubber washers made of automobile inner-tube rubber; they are about two and a half inches in diameter.

After osteotomizing both fibula and tibia, four seven-inch Steinmann pins are passed through the four previously prepared holes. In order to avoid injuring the fingers of the operator or his assistants on these sharp-pointed pins, we have found it advisable to protect them with suitable-sized, sterile corks. As soon as each pin is placed, these corks are put on the ends. We have found it unnecessary to lengthen the tendo Achillis. The osteotomy wound is closed in the usual way. The usual dry gauze

dressings are applied, over which is wrapped narrow sterile sheet wadding about two inches wide, completely enclosing the dressing under several layers.

Previously prepared sterile, rubber discs, approximately two inches in diameter, made from an automobile inner tube, with a hole punched in the middle just large enough to allow a Steinmann pin to be forced through, are then threaded on to the eight cork-covered, projecting pin ends. The corks must be removed, of course, to do this. These close-fitting discs are to prevent contamination of the small openings in the skin from without, along the surface of the pins. A few more turns of sterile sheet wadding are taken over the discs, and a leg plaster just a little thicker than usual is applied from toes to groin, with the ankle at a right angle and the knee slightly flexed, of course holding the bones in as good position as possible. Extra care is taken to adequately protect the foot with plenty of sheet wadding.

As soon as the plaster is throughly dry, which is usually in about thirty-six hours, a circle is marked around the cast half-way between the middle pins. Four drill holes are then made the correct distance above and below this circular mark, sufficiently large to allow the insertion of the slightly hooked ends of the completely screwed-up turnbuckles, whose end loops have been unrolled, as seen in the illustration. These holes are placed so that the turnbuckles will be located an equal distance from each other around the cast, and will receive the ends of the turnbuckles.

The turnbuckles which are employed can be ordinarily obtained at the average hardware store, and can be extended about two inches. They are prepared for use by unrolling their terminal loops, using a vise, so as to make an angle of a little less than ninety degrees with the threaded portion. The pressure exerted by the extending turnbuckles will be found sufficient to hold them rigidly in place. We have had no difficulty caused by having the ends of the turnbuckles force their way in under the plaster, this being obviated by the slightly acute angle that the straightened loop makes with the threaded portion.

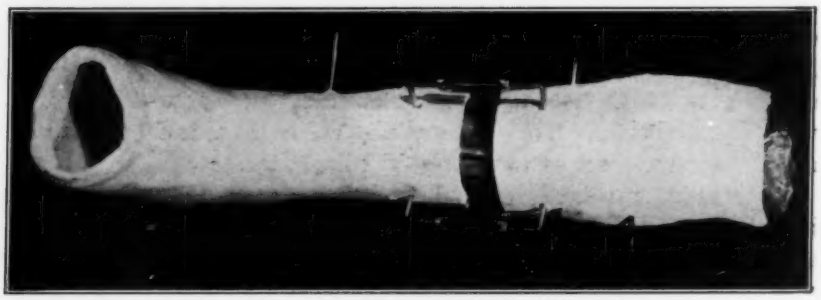

FIG. 2

Photograph of a model of the apparatus showing the pins in place, the turnbuckles in place and almost completely screwed out, showing the cut in the bone.

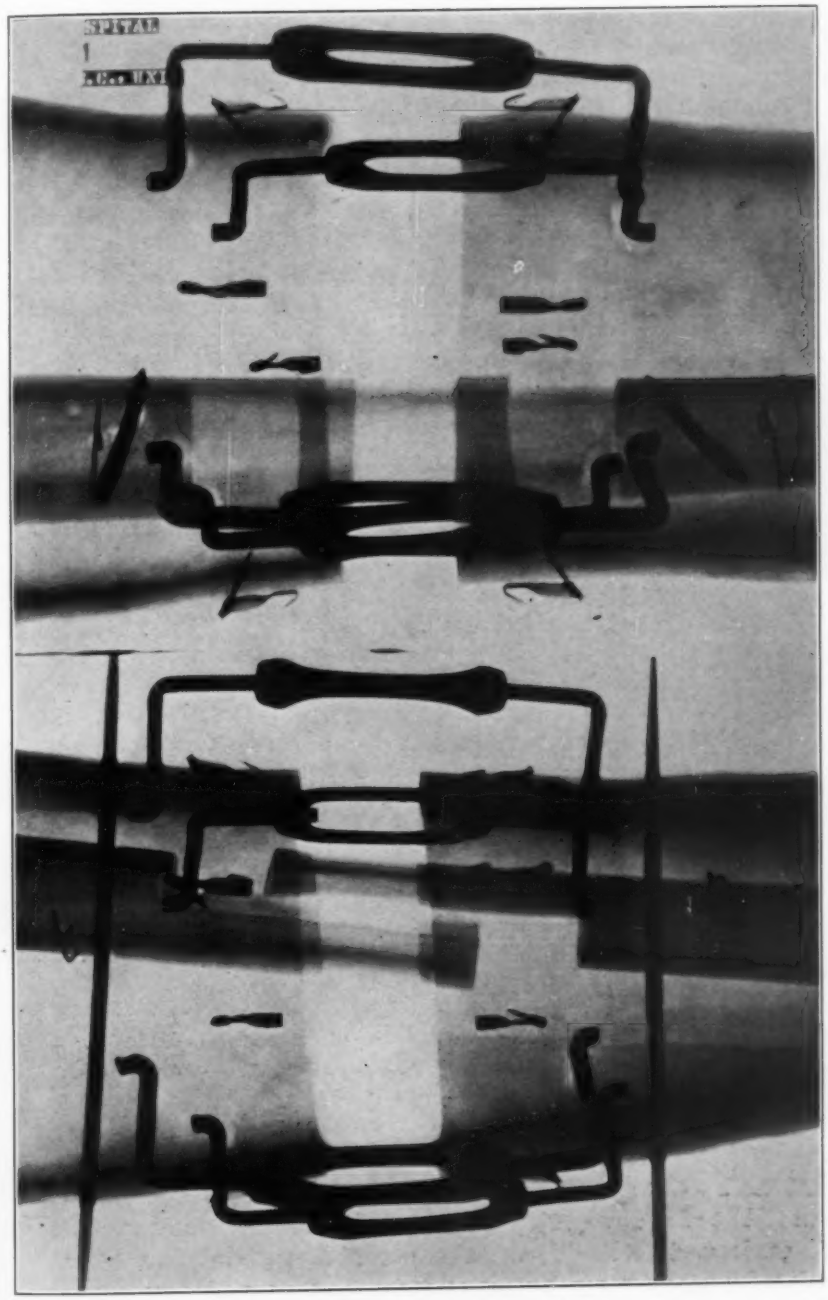

FIG. 3

X-ray of the model showing the arrangement a little more diagrammatically than the x-ray of the patient.

Before the ends of these turnbuckles are fitted into the holes, of course in the longitudinal axis of the leg, the cast is completely cut around where it had previously been marked. After doing this, the ends of the screwed-up turnbuckles are passed through their respective holes, one end of each turnbuckle in the distal portion of the cast, and the other end in the proximal portion. We have found it advisable to protect the cork-covered, projecting Steinmann pins with a few turns of plaster. All turnbuckles are then tightened, so that an equal pressure is applied on all sides to the two portions of the cast, for the purpose of maintaining correct alignment.

We have found that it takes about thirty complete turns of the turnbuckles we have used to extend them two inches. This is about their limit. The patient can tolerate very well one complete revolution of each of the four turnbuckles every day for the full thirty days. Our object has been to obtain two inches lengthening. If this has not been accomplished by the time the turnbuckles are completely extended, new holes can be made in the plaster midway between the ones previously used, and four new completely screwed-up turnbuckles, prepared in the same manner as the others, can be inserted, the holes, of course, being made the necessary distance from the cut edge of the plaster. The completely extended turnbuckles are removed as the new ones are applied. Actually, it will be

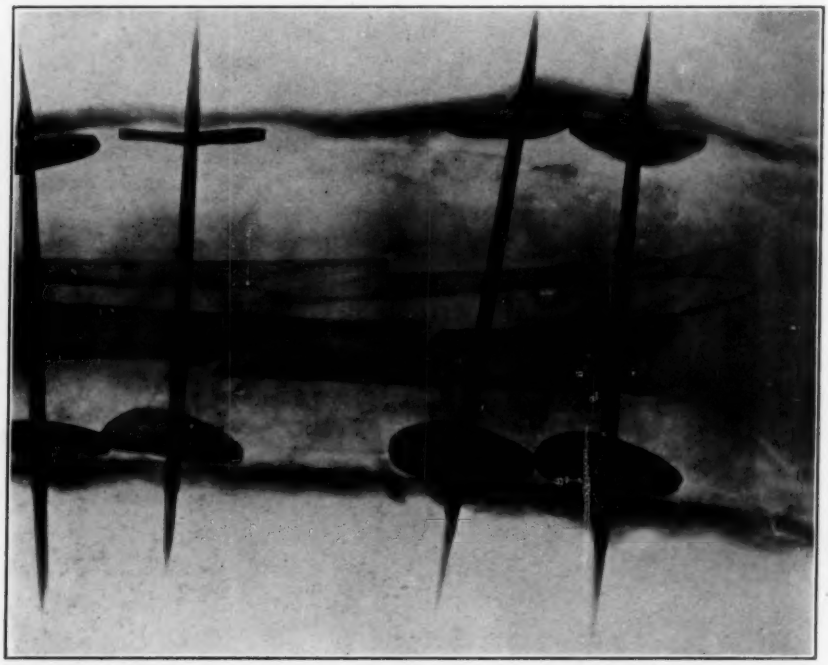

FIG. 4

X-ray of patient immediately after operation before the transverse cut around the cast was made and before the turnbuckles were inserted. It shows well the rubber washers placed between the sterile dressings over the wound and the cast.

Fig. 5. X-ray of patient after the turnbuckles had been screwed out almost two inches.

Fig. 6. X-ray taken three months after the original osteotomy, showing well the new callus and the approximate amount of lengthening. A brace is then to be worn for six months.

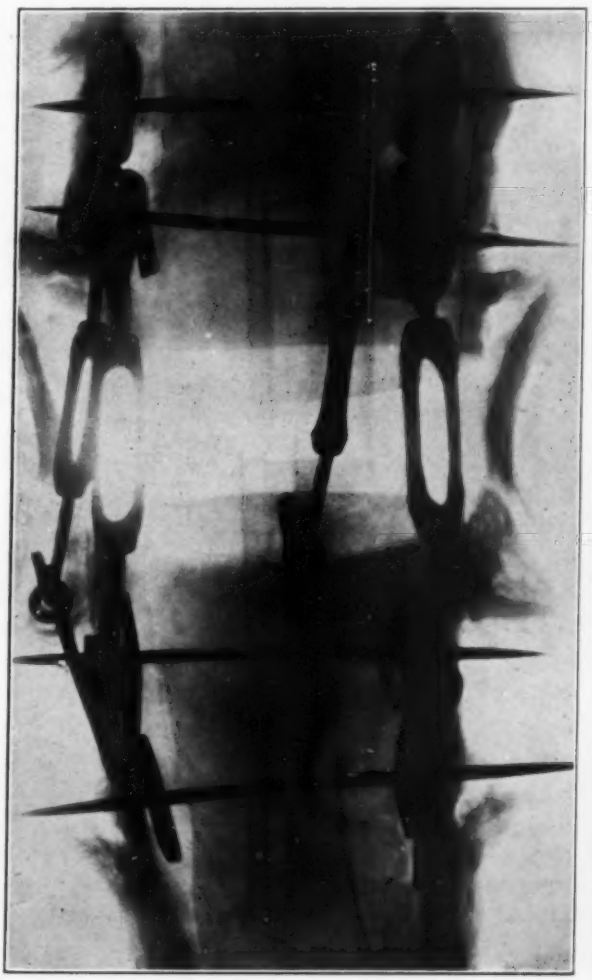

FIG. 5

FIG. 6

found that only one extra prepared turnbuckle is needed, as after this is screwed tightly in its holes, the completely extended ones on either side of it may be removed and, having been screwed up again, are placed in the newly prepared holes. The fourth turnbuckle can be easily shifted to its new location.

After the desired lengthening has been effected, and the alignment is satisfactory, a few turns of the plaster-of-Paris bandage are made around the entire apparatus to insure greater stability. This is left undisturbed for another month, at the expiration of which time sufficient plaster is removed to permit the removal of the Steinmann pins. Nothing further is done for still another month. At the end of this time, which is three months from the time of the original osteotomy, all apparatus is removed. X-rays are taken to determine the positions of the bones and the amount of bone repair. Measurements are taken for a leg brace with ring-lock knee joint extending to the groin, and with a close-fitting leather cuff from just above the ankle to just below the knee. Usually it will be found that by this time the Steinmann pin holes and the operation wound are thoroughly healed, and need no particular attention. A new plaster from groin to toes is then applied, and kept on until the brace is ready to be fitted. The brace is worn for six months to a year, depending on the speed of repair.

It might be added here that the fundamental principles of this apparatus can be profitably employed in fractures of the lower leg where otherwise an open reduction would be indicated. The term "Double skeletal traction" seems appropriate.

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THE STIMULATION OF BONE GROWTH BY VENOUS STASIS*

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The effect of alterations in the circulation on the growth of bone has interested many observers in the past and there exist records of marked changes in osteogenesis produced by circulatory derangement. Yet the modern works on bone growth and fracture treatment either make no mention of these known facts or devote to them a half-dozen lines of vague suggestion. Textbooks of orthopaedic surgery occupy chapters in the description of deformities and the mechanical means of their correction, but scarcely a page is used to define what is known of the fundamental processes governing bone formation. Yet, the most casual observation will reveal that in the case of bone lesions marked changes in the circulation are brought about by the abnormal positions required for fixation to secure subsequent function, by the pressure of dressings, splints, casts, pads, or other apparatus and by such adjuncts of therapy as baking, massage, hydrotherapy, diathermy, or other physiotherapeutic agents. Further, it will be observed that bone injury, such as a fracture, is nearly always accompanied by alterations in the circulation of the part,—such as cyanosis, rubor, ecchymosis, or oedema. So the question naturally arises, what is the effect of circulatory change on bone growth? Should the cyanosis or oedema present after injury be combatted, or are they essential parts of the reparative process? Does the active hyperaemia produced by physiotherapy promote or retard union? Would a tight splint or cast which obstructs the superficial circulation influence repair of the lesion? Would apparatus such as an axillary pad, which may cause pressure on the deep veins, accelerate or slow bone repair? Is it possible that some of the bone diseases, so called, are merely manifestations of circulatory derangements or perhaps nervous derangements acting through vasomotor channels? These and many other questions arise on consideration of the problem and they are not answered by the literature on the subject.

If bone growth is influenced by changes in the circulation, then it is conceivable that alterations in the venous circulation, the arterial circulation, or the vasomotor mechanism might have very different effects. It is our purpose to discuss that phase of the subject which deals with the effect of venous stasis on osteogenesis. This portion of the subject has received more attention, perhaps, than any other and there exist excellent clinical observations on the influence of venous stasis on bone growth. These observations, coupled with our experimental and clinical demonstrations, warrant the statement that venous stasis stimulates the growth of bone and accelerates the healing of fractures.

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The earliest record of the use of stasis hyperaemia in retarded callus formation is by Ambroise Paré[19], who says, "If, however, the callus is too small and undeveloped . . . a bandage should be applied beginning at the root of the vessels, if on the leg close to the inguinal region, if on the arm near the shoulder, and reaching nearly to the seat of the fracture. For by this remedy the blood is squeezed out and compelled to flow to the injured place."

Later Nicoladoni[16], without being aware of Paré's work, advocated v. Dumreicher's method for treating impending pseudarthrosis; he states that "an artificially produced and permanently maintained hyperaemia will exercise a powerful stimulus on the tissues and tissue elements which participate in callus formation". In practice Nicoladoni produced hyperaemia with a rubber tourniquet above the fracture, while the limb distal to the lesion was firmly bandaged with a flannel bandage. He not only used this method for the treatment of delayed union, but also to more quickly fill in bone cavities.

In 1886 Thomas[29] published his observations on fourteen cases of bone fractures with retarded callus formation treated by venous stasis and, being unaware of the previous work, considered himself the inventor of the method.

The next year Helferich[9] presented eight cases of retarded callus formation in which stasis hyperaemia was successfully used, and three other cases in which it was combined with nailing of the fragments together. He advocates venous stasis as an agent to increase deficient callus formation and to stimulate bone regeneration.

Bier[5] in his book on hyperaemia points out the earlier uses of venous stasis and says that if the widely used expression "Bier's stasis" is to mean that he introduced the method of stasis hyperaemia, then he must decline this, since it had been used previously in bone lesions. Bier includes an excellent bibliography and we are indebted to his work for much of the historical review.

Thus, from this brief survey of past work, it is noted that several observers have recorded clinical improvement in the repair of bone in the presence of venous stasis. Additional evidence of the truth of this fact is derived from a study of pathological states. Stanley[26], Paget[18], v. Bergmann[4] and others[12, 17, 24] have shown that any long continued inflammatory process which results in venous congestion will be followed by increase in the length and thickness of the bones. This response follows a number of causative factors such as irritation of the periosteum, the introduction of foreign bodies, or the presence of a chronic ulcer of the leg in a young person.

Other sources of venous congestion with resultant hyperplasia of bone are found in arteriovenous aneurysms, angiectasis, and varicose veins.

Broco[6] cites a seventeen-year-old boy with an arteriovenous aneurysm of two years' standing, below the inguinal ligament, who had two centimeters increase in the length of the thigh. Krause[11] describes a case

with an arteriovenous aneurysm of the forearm with marked venous hyperaemia that resulted in an increase of one and one-half inches in the length of the forearm. Israël[10] presents an instance of five centimeters' lengthening of a leg from the venous hyperaemia of congenital angiectasis. Spencer[25], Axhausen[3], Stilling[27], and Greig[8] have mentioned the relation between osteogenic hyperplasia and varicose veins in young subjects.

Cone[7] has demonstrated that passive congestion resulting from cardiac failure and the congestion of arteriosclerotic extremities may result in a hyperplasia of bone, and he states that "alternations of active and passive congestion are more influential in upbuilding than the steady continuation of either".

Von Recklinghausen[23], Adami[1], Ziegler[31] and others have noted the correlation between vascular congestion and osteoplasia in a number of different circumstances.

Perhaps the most remarkable demonstration is that of Helferich[9] who employed venous stasis to produce hypertrophy of bone in normal limbs. He records the following examples:

a. A girl, sixteen years old, had an increase of three centimeters in the length of a limb following a chronic ulcer, and the opposite, healthy, extremity was lengthened two centimeters by the use of passive hyperaemia.

b. A boy, ten years old, had shortening of three and one-half centimeters following a fractured femur, and the leg was lengthened one and one-half centimeters subsequent to the use of stasis hyperaemia.

Thus there is evidence to show that venous stasis will accelerate bone growth, whether the stasis is produced intentionally as a therapeutic agent or results from a pathological process.

Leriche and Policard[13], Stropeni[28], Putnam[22], White[30], and others have suggested an indirect vascular effect on bone growth by the sympathetic nervous system, and this may well be another phase of the effect of venous stasis on osteogenesis. In some previous experimental studies from this laboratory evidence was presented that indicated an accelerated reaction of bone formation following venous stasis[14]. The present report is a more complete exposition and more controlled extension of the previous observations.

It is our purpose here to recall the observations made in the past, to present clear-cut experimental proof that venous stasis accelerates the healing of bone, and to advocate this method of treatment, so long neglected, as a valuable adjunct of therapy in bone lesions.

EXPERIMENTAL METHOD

Adult dogs, which in every instance received preliminary medication of one-quarter grain of morphia and ether anaesthesia, were used. All operative procedures were done with surgical asepsis. The fibula was selected as the most desirable bone because of its accessibility and because the limb is adequately splinted by the intact tibia, thus obviating the use

of fixation during repair. A small portion, two to four millimeters, was resected near the proximal end of the bone, usually about three centimeters from the head of the fibula. In all cases exactly the same size fragment was resected in the same location on the two limbs of the animal, so that the operative procedure on the two legs was as nearly alike as possible.

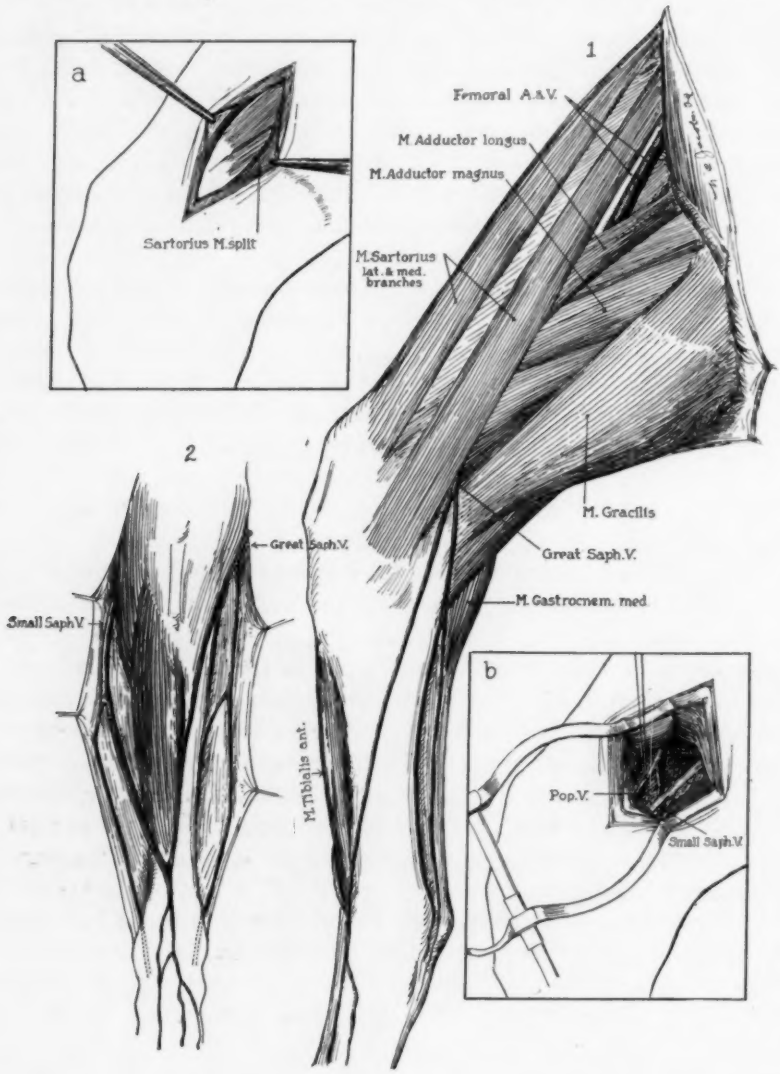


FIG. 1

1. The superficial anatomy of the dog's leg on the inner side, showing the great saphenous vein draining the medial surface.

2. The superficial venous circulation of the lower leg. The small saphenous drains the lateral surface; the great saphenous drains the medial surface. The anastomosis of the superficial systems is shown.

a. The operative approach to the vessels in the popliteal space.

b. The muscles are retracted, the venous bifurcation identified, and the popliteal vein ligated.

Great care was taken to preserve the periosteal bridge, since interruption of the continuity of the periosteum allows muscle to come between the fragments, and fibrous union results. The periosteum was not sutured. The wounds were closed in layers with silk.

After the resection of a portion of the two fibulae, one was left as a control and the vein of the opposite limb was ligated. To understand the rationale of this step of the procedure, a knowledge of the venous circulation is essential.

The femoral vein of the dog receives a branch, the great saphenous vein, which drains the subcutaneous region on the medial aspect of the limb (Fig. 1, *1*). The femoral vein then goes beneath the muscles and ends in the popliteal space in two large branches. The larger of these two branches, which is a continuation of the main channel, then becomes superficial and drains the lateral surface of the lower limb. It is comparable to the lesser saphenous vein of man, except that it is the main continuation of the parent trunk. This vessel anastomoses with the greater saphenous vein coming from the medial surface, and forms with it a loop which intimately connects the superficial venous circulation (Fig. 1, *2*).

The other branch, the popliteal vein, which joins the main channel in the popliteal space, is the vein from the deep structures and it is this vein that comes from the bone. Its main channel lies just posterior and medial to the knee joint and its occlusion impairs the venous return from the bone. This, the vein coming from the bone and deep structures, was ligated and divided just distal to its confluence with the femoral vein. The approach was through a small skin incision on the medial surface of the thigh just above the femoral condyle. The sartorius muscle was split in the plane of its fibers (Fig. 1, *a*). The cleavage plane between the fibers of the semimembranosus muscle was identified, separated, and the mus-

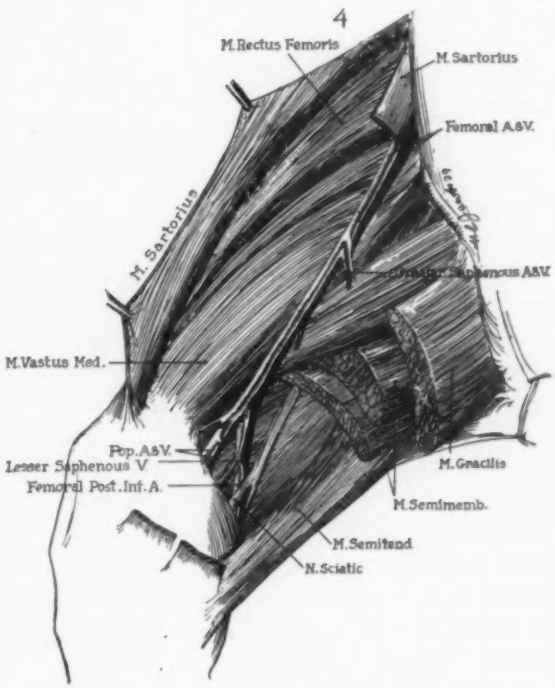


FIG. 2

The anatomy of the dog's leg. The superficial muscles have been resected, the muscular and great saphenous branches have been removed. The bifurcation of the vessels in the popliteal space with their relation to the sciatic nerve is shown.

cle retracted. The fat of the popliteal space was then divided, the junction of the two main veins exposed, and the popliteal vein below the saphenous branch ligated (Fig. 1, *b*). The relation of the vessels to adjacent structures is shown in Figure 2.

The animals were allowed to recover and it was found that they walked without discomfort. X-rays were taken of the two limbs shortly after the operation and at three-week intervals until union occurred. The specimens were then obtained and x-rayed directly.

RESULTS

Twelve dogs were operated upon. In one animal non-union of both sides resulted, apparently because a thin, fragmented periosteum allowed muscle to come between the fragments.

In every other instance union was accelerated on the side having the vein ligated. This was manifested by earlier formation of callus, earlier calcification of callus, and earlier union. A typical series of roentgenograms is shown in Figures 3 and 4. It was frequently observed that firm union had resulted on the side having the vein ligated, while on the control limb callus and abnormal mobility were present. This is shown by Figures 5 and 6, where it will be seen that the reparative process in the presence of venous congestion is definitely accelerated over the normal rate of repair. These results are taken as proof of the fact that venous stasis accelerates bone growth.

CLINICAL OBSERVATIONS

It was felt that the experiments here recorded adequately substantiated the clinical reports to the effect that bone growth is accelerated by venous stasis. But we wished to see for ourselves the effect of this therapy when applied to cases of delayed union.

Of course there is a difference in the mechanism of the production of the hyperaemia in the clinic and in the experimental studies, and one might expect a difference in the degree of its effect. In dogs it was possible to ligate the vein a short distance from the bone, while in patients the venous stasis was obtained by a blood pressure cuff intermittently inflated to a little above diastolic pressure at a point proximal to the fracture. This latter method would not give the same intensity of stasis as that produced by the actual ligation of the vein from the bone, but we have not felt justified in attempting operative procedures. In the case of lower leg fractures one might ligate the popliteal vein below its lesser saphenous branch, since it is known[15] that in other circumstances this does no harm.

Thus far five cases of delayed union have been treated by venous stasis hyperaemia. Two cases are reported in detail.

CASE 1. E. F., a nurse, forty-six years of age, was walking through a corridor on October 30, 1927, when she slipped and fell. Her left foot struck against the side

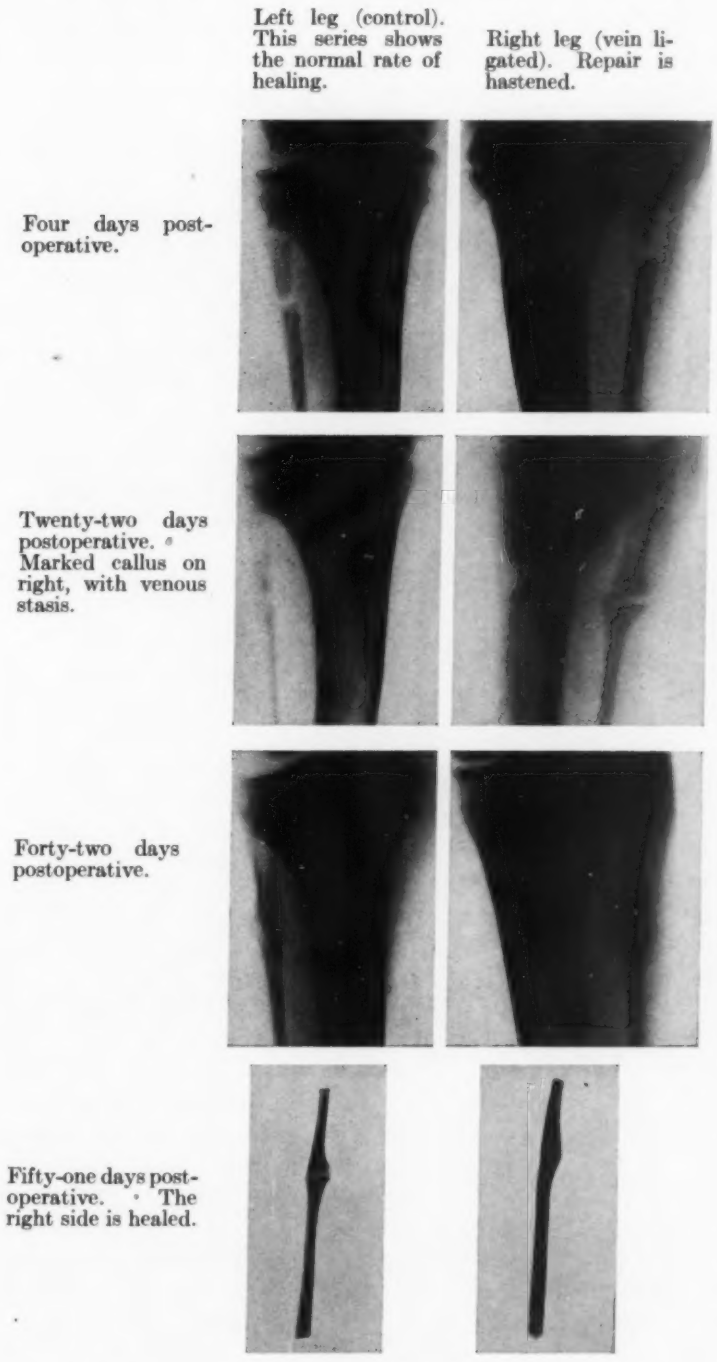
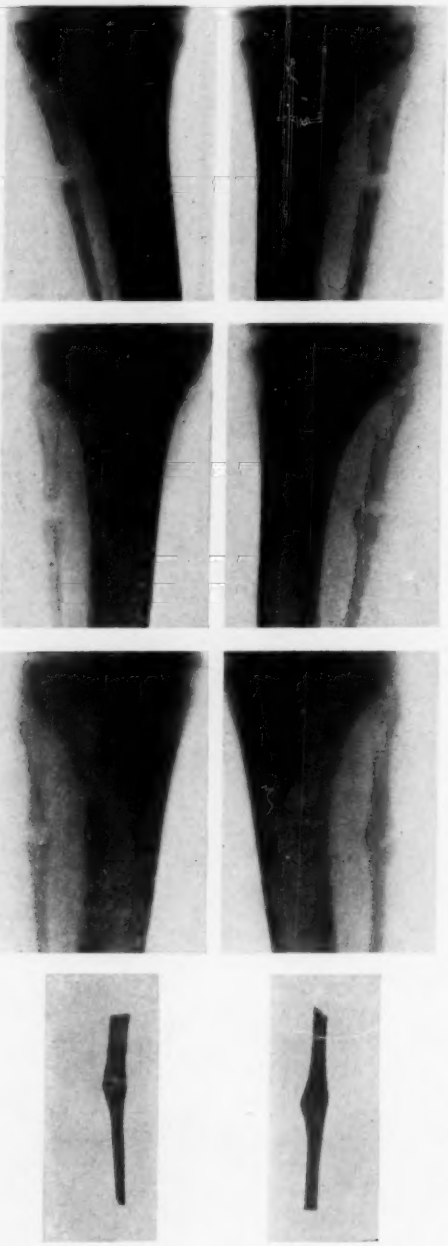

Left leg (control). This series shows the normal rate of healing.
Right leg (vein ligated). Repair is hastened.
Four days postoperative.
Twenty-two days postoperative. Marked callus on right, with venous stasis.
Forty-two days postoperative.
Fifty-one days postoperative. The right side is healed.

FIG. 3

Dog 27–270. Roentgenograms showing the amount resected from each fibula and the more rapid healing on the side having venous stasis produced.

Left leg (control). This series shows the normal rate of healing.

Right leg (vein ligated). Accelerated repair.



May 24. The amount of bone resected.

June 15. Note callus on right.

July 5.

July 14. The bone has healed on the side having venous stasis.

FIG. 4

Dog 27–271. A typical series of roentgenograms showing accelerated healing with venous stasis.

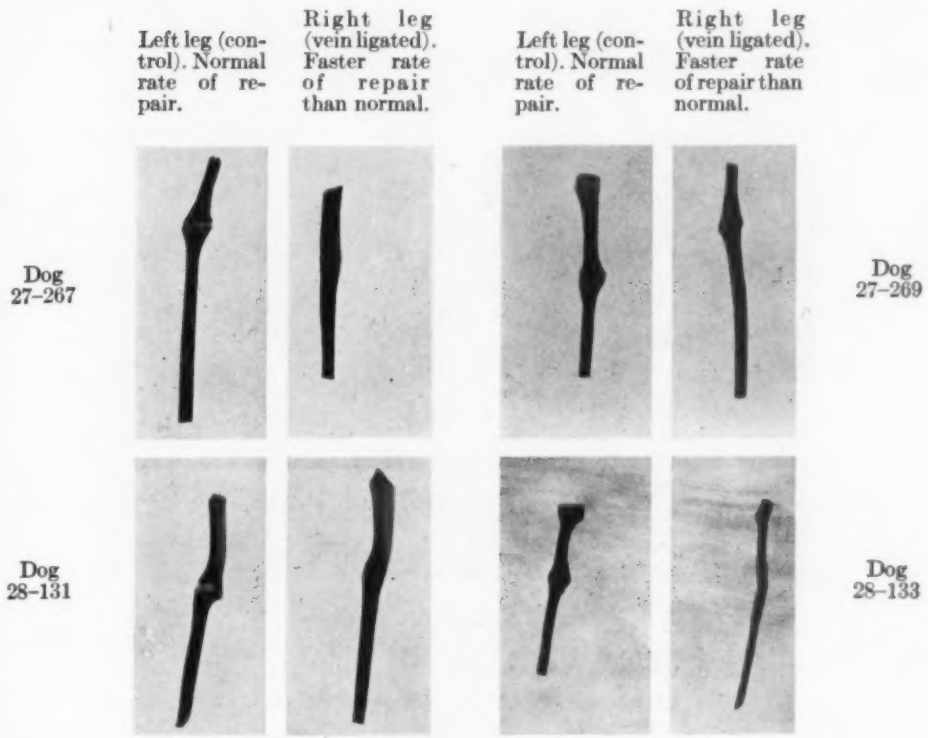

Left leg (control). Normal rate of repair.
Right leg (vein ligated). Faster rate of repair than normal.
Left leg (control). Normal rate of repair.
Right leg (vein ligated). Faster rate of repair than normal.
Dog 27–267
Dog 27–269
Dog 28–131
Dog 28–133

FIG. 5

The end result of four experiments showing the relative stage of healing in the two sides. It will be noted that firm union has occurred in the bones subjected to venous stasis while callus is present on the control side.

of the wall. She suffered pain along the outer border of the foot and examination showed evidence of a fracture of the fifth metatarsal bone. Roentgen-ray examination confirmed the physical findings, revealing a comminuted fracture of the base of the fifth metatarsal (Fig. 7). Contrast baths of hot and cold water were given and the foot strapped with narrow strips of adhesive tape.

November 5, 1927: She was allowed up on crutches, as the swelling had subsided.

November 11, 1927: The roentgen-ray negatives showed no evidence of callus. The fracture was in good position.

December 2, 1927: There was still no evidence of callus formation on roentgen-ray examination. Cod liver oil was prescribed and heliotherapy with carbon-arc light. Weight-bearing was not possible on account of discomfort.

December 18, 1927: The swelling of the foot and leg have been quite marked. Baking and massage gave some but not complete relief. The foot was cold, bluish, swollen and painful. The roentgen ray showed no evidence of callus.

December 19, 1927: The blood pressure was determined—160 systolic, 120 diastolic. A blood-pressure apparatus was applied just below the knee and maintained at a pressure of 130 as long as she could stand it. She kept it on for some time without discomfort and was given the apparatus to apply at night. During the day an elastic band was used much the same as a garter, care being taken to be sure that the arterial pulse could still be felt in the foot. Cod liver oil, light therapy, baking and massage were all discontinued.

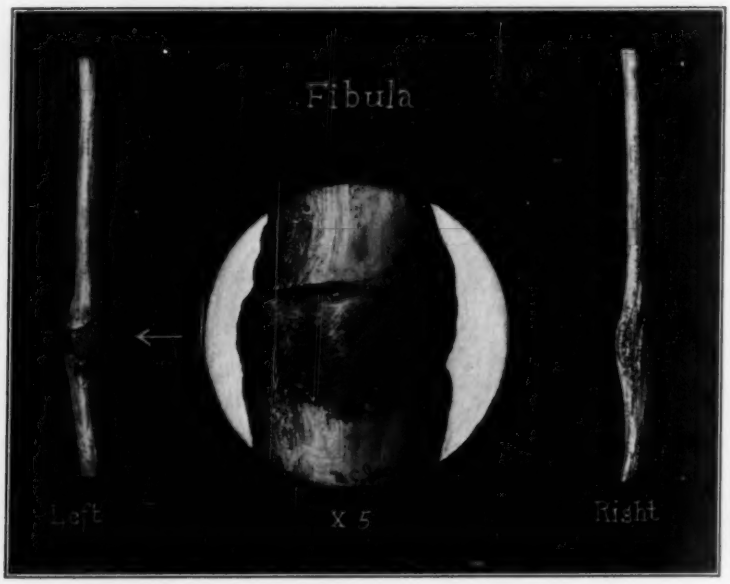


FIG. 6

The amount of callus which remains with normal healing at the stage when the bone of the opposite leg is healed. The right side had the vein ligated.

December 20, 1927: The patient reported today that her foot felt "alive and warm for the first time since the injury". The swelling was for the most part gone, a little remaining in the region of the fracture.

December 27, 1927: Roentgen rays taken today showed almost complete filling in of fracture lines (Fig. 7). The swelling and tenderness were practically gone. Weight-bearing to be tried today.

January 6, 1928: She has been walking with a support under the arch and is comfortable. The swelling and tenderness are gone.

January 31, 1928: Patient is now walking without any evidence of her injury.

Summary: A woman who had a fractured left fifth metatarsal bone in good position was treated for seven weeks by immobilization, baking, massage, cod liver oil and carbon-arc heliotherapy without showing any evidence of callus formation. All therapy was discontinued except passive compression of the deep venous return, with the result that there was local improvement in the pain and swelling within twenty-four hours, and callus formation within one week. Line drawings of the roentgenograms taken before and two weeks after the use of venous stasis hyperaemia are shown in Figure 7.

CASE 2. I. B., a woman of thirty years of age, was admitted to the hospital on October 3, 1927. She had been in an automobile accident on August 7, 1927, at which time she received numerous lacerated wounds of the face, left arm, and hand, as well as fractures of the left mandible and both bones of the left forearm. At another hospital an open reduction of the fractured forearm was carried out, the bone ends being sutured in alignment with kangaroo tendon. A plaster cast was applied. An osteomyelitis of the left mandible developed. The arm became swollen and the fingers somewhat contracted in the cast, and accordingly the cast was removed. Roentgen rays taken four weeks after the accident showed malposition and non-union of the arm bones.

On examination she showed numerous puckered, deep, wide scars of the left side of the face; a draining sinus leading from the posterior portion of the left mandible; non-union of the left lower jaw with osteomyelitis; and marked distortion of the sym-

metry of the face, due to a previously unrecognized fracture of the maxilla. She could open her mouth only about one centimeter. The left forearm was in another cast which extended from the mid upper arm to the bases of the metacarpals, the elbow joint being held at a right angle. On removal of the cast the forearm showed dorsal bowing of the radius, stiffness of the wrist, extension contracture and stiffness of the fingers. The hand was swollen, shiny and blue, and the slightest motion was painful. In addition to the above findings, there was a marked secondary anaemia due to menorrhagia for which no cause could be found on examination. Her red blood count was 2,660,000 and the hemoglobin was forty-two per cent. (Sahli). There were one per cent. reticulated cells as determined by the wet method. Roentgen-ray examination showed fractures of the radius and ulna in their middle thirds. There was ulnar displacement of the upper end of the radius and overriding. The ulnar fragments were in good position. The left jaw showed a transverse fracture and osteomyelitis, with no callus formation.

The patient was put on a liver diet, given several transfusions, and carbon-arc-light therapy was used. The dead bone was curetted from the jaw sinus. Physiotherapy was started on the hand and arm. Orthodontia appliances were placed on the upper and lower jaws to attempt to move the teeth into proper occlusion.

An open reduction of the left radius was done on November 30, 1927, because of the malposition and non-union. There was a fibrous union present with an overriding of one and five-tenths centimeters. The fragments were freshened and dovetailed into each other in good position.

Roentgen rays showed good alignment but no callus formation on December 5, but on December 10 there was increased angulation of the radius fragments due to crumbling of the bone ends. Manipulation reduction was not successful; so a second open operation was done on December 14; holes drilled through the fragments and kangaroo tendon laced through, getting excellent approximation.

Roentgen rays on December 19 and December 27 showed callus formation about the ulna but no change near the radius.

On January 7, 1928, blood-pressure apparatus was applied around the upper arm, keeping the pressure between systolic and diastolic, about 90 to 100. On January 27, 1928, the blood-pressure apparatus was used at seventy-five millimeters and it was found that this was much better tolerated. The arm got blue and there was a prickling

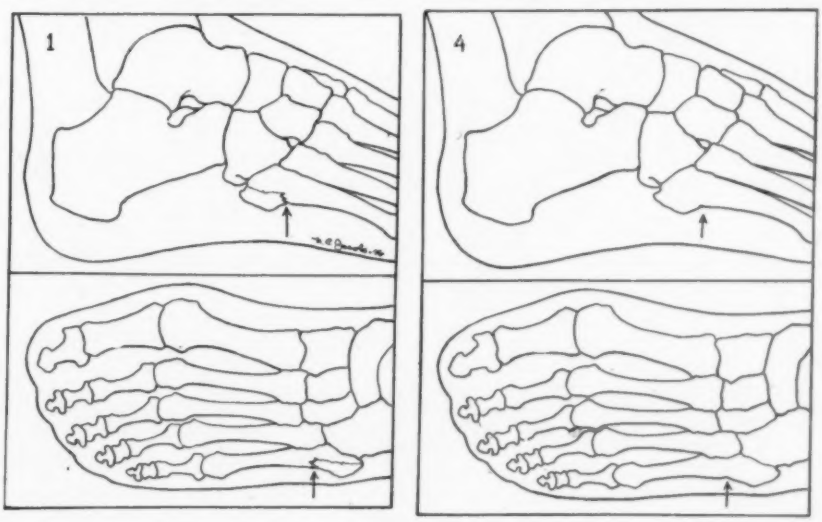


FIG. 7

Line tracings of roentgenograms in Case 1, showing in *1* the unhealed, and in *4* the completely healed fracture two weeks after venous stasis hyperaemia.

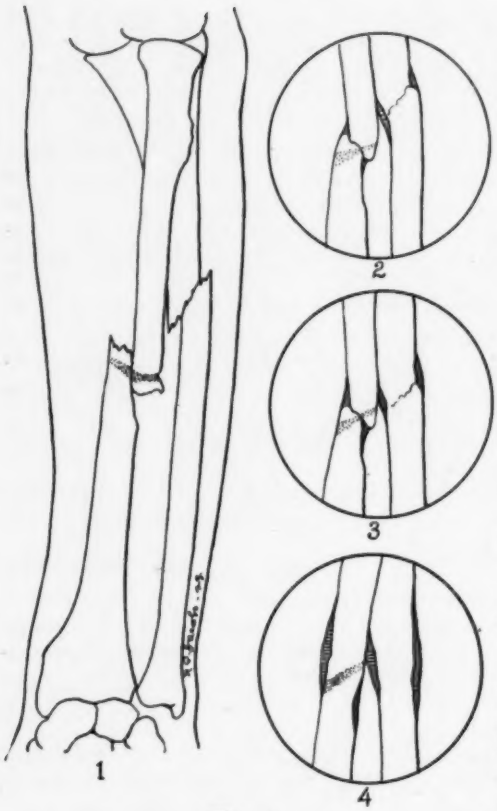


FIG .8

Case 2. Ununited fracture of radius and ulna.

1. The original condition.

2, 3, 4. The position of reduction and the healing with venous stasis hyperaemia.

sensation in the hand, but she could keep the pressure on for twelve minutes at a time. She was also given an elastic arm band to keep on as much as possible. The cast was removed on February 1; the arm seemed to be in fair shape.

Roentgen rays taken February 4 showed marked callus about the ulnar ends and a moderate amount around the radius.

Physiotherapy was continued on the hand and arm; and also venous stasis by elastic compression. There was a large callus formation, easily made out clinically, with solid union toward the end of February.

Roentgen rays on March 5 showed a very satisfactory amount of callus about both the ulna and radius.

Line drawings of a series of roentgenograms are shown in Figure 8.

Summary: A woman, thirty years of age, sustained fractures of the radius and ulna that were treated by open reduction and suture of the fragments in position. On admission to this clinic two months after injury, non-union of the radius with malposition of fragments and no callus existed. Conservative treatment was tried for six weeks with no result. Open reduction of radius showing fibrous union, the fragments were freshened and dovetailed together. In two weeks the ends of the bones crumbled and the position was poor, so fragments were sutured in position. There was no evidence of union. Venous stasis hyperaemia for one month resulted in good callus formation and union, and permitted removal of cast.

The three other cases treated by venous stasis hyperaemia are of little value in determining the result of the therapy.

One case was that of a man of thirty-five years, a syphilitic, with a fracture of the radius which did not heal. Open reduction with suture of the fragments did not give union. Venous stasis hyperaemia resulted in marked callus formation but firm union did not occur until after anti-syphilitic treatment.

Another case was that of a man with a badly comminuted compound fracture of the tibia and fibula that became infected and did not unite. Venous stasis hyperaemia resulted in some callus formation, but an extension of the osteomyelitis made amputation necessary.

The last case, that of a woman of twenty-six with an ununited fracture

of the surgical neck of the humerus, has not been under treatment long enough to determine the result*.

DISCUSSION

It has been shown that venous congestion stimulates osteogenesis, and the question arises as to the cause of this phenomenon. While no direct answer is to be found for this question, yet it is interesting to speculate on the possibilities involved. Studies on the blood changes (Peters, Bulger, Eisenman and Lee)[20] in venous stasis have revealed an increase in the volume of the formed elements, an increase in total plasma proteins and an elevation of oxygen capacity and carbon-dioxide content. The pH falls and relative acidity prevails. The total acid and base of the plasma remain relatively constant, while the salt content is apparently unchanged.

Recent researches have demonstrated that there exist sterols or ergosterol-like substances which, when irradiated, exert a profound influence on calcification of bone. The presence in the body of minute quantities of these substances will serve to bring about calcification in rickets, and one may possibly conceive of rickets as a disease of a deficiency of irradiated sterols. Since these substances exist in the body and since with venous stasis the formed elements of the blood and total protein are increased, it is possible that the ergosterol-like substances are also increased and that their concentration in the region of a bone injury would accelerate repair.

Another possibility is the relation of the change of pH being a factor in accelerating the reparative process. It is known that the pH decreases in the presence of venous stasis, but whether this is true for the long duration of our experiments has not been demonstrated. The solubility of calcium increases, within limits, with diminution of the pH, and in this way the presence of an acid media about a bone injury might accelerate calcification.

Peterson[21-A] has shown that the product of the calcium and phosphorus of the blood is often low in cases of ununited fracture and that dietary regulation of these elements to produce a low value will result in non-union. The effect of venous congestion on the calcium and phosphorus content of the blood is not known, but it would appear reasonable to suppose that they are increased along with most other constituents. If this is the case, they may play a part in the accelerated bone formation with venous stasis. It will be recalled that Albee[2] has shown that triple calcium phosphate, when placed between the ends of the fragments, promotes bone growth.

Another interesting possibility is the influence of small amounts of iron on the healing of bone lesions. It has been observed by Peterson[21-B] that iron is present in the callus during calcification. This may be correlated with the observation of MacCallum that the solubility of calcium is markedly altered by minute amounts of iron. The deposition of iron pigments with the chronic passive congestion of myocardial failure is well

*Since writing the paper, this patient has developed abundant callus, followed by firm union and good function.

known. Certainly the venous congestion produced in our experiments would give an abundance of iron about the callus and this might be a factor in the accelerated repair.

The foregoing discussion is purely speculation and arrives at no conclusion, for it deals with the chemical factors of bone formation, and of these little is known. But there are other facts of a more practical nature which are worthy of note. It has been observed clinically that stasis hyperaemia promotes healing of fractures in which delayed union has occurred. It is not felt that this is a rational treatment of long existing non-union or pseudarthrosis, where surgical treatment is indicated. Likewise venous stasis will not take the place of surgery when muscle is interposed between the fragments or faulty alignment exists. In other words, it is not a substitute for good surgery. But if union is delayed, when it should be expected by the position of the fragments and condition of the injury, then stasis hyperaemia offers an adjunct of therapy worthy of trial.

That one type of circulatory alteration, namely venous stasis, will influence the growth of bone has been demonstrated. The effect of ischaemia and arterial hyperaemia will be studied, for it is considered important to know the effect of the circulatory factors in osteogenesis. Bone lesions are accompanied by vascular changes such as hemorrhage, cyanosis, rubor, and oedema. Their treatment with fixation, casts, splints, apparatus, and physiotherapy introduces other factors which have an influence on circulation. So that as a result of the lesion and the treatment, circulatory alteration will result; and unless one knows its effect, harm may be done by well intended treatment and the purpose of the therapy defeated.

CONCLUSIONS

1. Reports are presented from the literature which show that fractures with delayed union may be healed by venous stasis hyperaemia.
2. Cases are presented to confirm these reports.
3. Experiments are recorded which demonstrate accelerated union of bone in the presence of venous stasis.

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THE PARALYSES OF POTT'S DISEASE*

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The general causes of the palsies of Pott's disease have long been known. In a word, the distal cord disturbances at times complicating spinal tuberculous disease are due to pathologically thickened dural coverings, to direct bony pressure on the cord, or to the encroachment of canal abscesses, either local or psoas.

Our object is to differentiate between the various types of paralysis; to emphasize a few points in diagnosis; and to discuss the futility of surgery in most of the types.

Until recently, little of importance has been added to the original contribution of Bradford and Lovett upon the subject. During the past five years advances have been notable among the French and English neurologists and orthopaedic surgeons.

All paralysis due to spinal tuberculosis is disappearing in America in proportion to the general decline of Pott's disease. In the West fewer cases are seen than twenty years ago, and we believe that the observations of Wallace[1] in 1924 are correct. Philanthropy and prophylaxis have checked the hump-back.

AMERICAN *vs.* EUROPEAN VIEWPOINTS

In America the decreasing volume of cases is emphasizing further prophylaxis, rather than intensifying our interest in pathology. There is a decided tendency toward spinal fusions in attempts, either before or after the onset of the paralysis, to stabilize the spine, with the thought that mobility is an augmenting factor in the cord paralysis; and further, we have tended toward spinal explorations when paralysis has persisted.

In Europe surgeons are still seeing many terminal Pott's palsies, because of economic conditions. Naturally, being analytically inclined, they may differentiate types more closely than we, and are more prone to give definite prognoses. While beginning to take an interest in America's stabilizing spinal procedures, the Europeans have only recently used them.

AN UNNECESSARY COMPLICATION

These paralyses from spinal disease are common among the untreated cases; are frequent among those patients treated while up and about in casts and braces, and even after bone graftings, in the so called "ambula-

*Read before the Orthopaedic Section of the American Medical Association, Portland, Oregon, July 1929.

tory" methods. From ninety to ninety-five per cent. of all Pott's paralysis appears among patients treated in these two ways. Paralysis appears among the afflicted at any age, — though it is largely a juvenile complication.

Any of the types of paralysis is almost unknown among patients treated continually with recumbency from the onset.

Types of Paralysis That Recover

Any palsy that starts early in spinal tuberculosis, that is sudden in onset, and that completely paralyzes the affected limbs and body is, as a rule, a curable type of palsy.

TYPE 1. ACUTE CORD OEDEMAS. RECOVERABLE

The simplest type of Pott's paralysis is due to a simple oedema of the cord. The dural membranes partake of a localized inflammation that in turn causes enough circulatory change in the cord and enough increased pressure on nerve structures to produce a distal paralysis. Avoiding the controversy over the cord pathology productive of such palsies, it is enough to say that during the period of peripheral palsies the cord temporarily suspends function. Drs. Etienne Sorrel and Sorrel-Dejerine[2] of Paris use the term "precocious paralysis" as descriptive of this curable type. These paralyses are complete and of short duration. The following case is typical:

Fig. 1

Paraplegia due to bony compression and sequestration of vertebral bodies, with permanent cord sclerosis. *From Sorrel and Sorrel-Dejerine collection, Hospital Maritime, 1926.*

Case 1. A. C. D. Male, aged thirteen years, weight forty-nine pounds. Slight kyphosis including the tenth and eleventh dorsal vertebrae, without com-

FIG. 2

Paralysis due to acute bony angulation in Pott's disease. Recovery after simple laminectomy. Note the extreme acuteness of angulation at junction of dorsal and lumbar spine (Case 2).

plete wedging of bodies. Had had a diagnosis of spinal tuberculosis over a year before, but had had indifferent treatment in ill-fitting casts and had attended school. Paralysis appeared suddenly three weeks prior to first examination, following a case of supposed influenza. Both legs became completely paralyzed in one week, sphincters were uncontrollable. Motor paralysis was complete, considerable spasticity was present, with twitching at times in the legs. Tactile sense was diminished but never entirely absent.

Hyperextended frame treatment was immediately begun, with a slight return of toe and foot flexion and groin adduction in both legs on the fourth day. On the fifteenth day we were first certain that all paralyzed groups were recovering. The urinary sphincter was insufficient for a few weeks. Outcome, complete recovery from the paralysis.

TYPE 2. CORD KINKING FROM ANGULATION. RECOVERABLE

Second, in young children there is, contrary to the belief of some, a simple pressure paralysis due to the sharp angulation of the spine and cord — a myelitis — independent of other causes. If this rare compression is fortunately relieved before cord degeneration is marked, the recovery usually is prompt. This of all types of Pott's paralysis might be considered a surgical type. Extension usually fails and early radical measures are necessary. About three out of a hundred paralytic complications are of this type.

During 1926 a controversy raged among such foreign medical journals as the *Archives Franco-Belges de Chirurgie*[3] and the *Revue Neurologique*[4] of Paris over the statement of the Sorrels that their researches did not permit of the opinion of simple bony pressure as a cause of Pott's paralysis. They insisted that *simple angulation* of the spinal canal by vertebral destruction could not cause a paraplegia because the ligaments, the bodies, and their laminae always maintained an integrity which did not permit a great diminution in the caliber or form of the medullary canal as long as the bodies remained units and before sequestration. This contention they later retracted. The Sorrels, who have done much to clarify our knowledge of paralytic pathology, have never minimized the importance of paralysis from vertebral sequestration (Fig. 1).

The following case illustrates this type, and while rare, it parallels a case reported by Armour[5] of London:

Case 2. W. B., male, aged ten. Had been treated by the author since incipiency of spinal tuberculosis in the fifth and sixth dorsal vertebrae (Fig. 2), years in recumbency and years ambulatory. In spite of treatment a fairly sharp angulation between the shoulders resulted. After losing sight of the case for three years, the writer was again consulted because of a slow progressive paralysis, with alarming spasticities, which had been developing for several weeks. Lateral radiograms disclosed a marked narrowing of the medullary canal at the angulation. But because the angulation had been stationary so many years, because of

Fig. 3

Same case as Fig. 2. Showing recovery of complete paralysis due to cord kinking and bony angulation following surgery (Case 2).

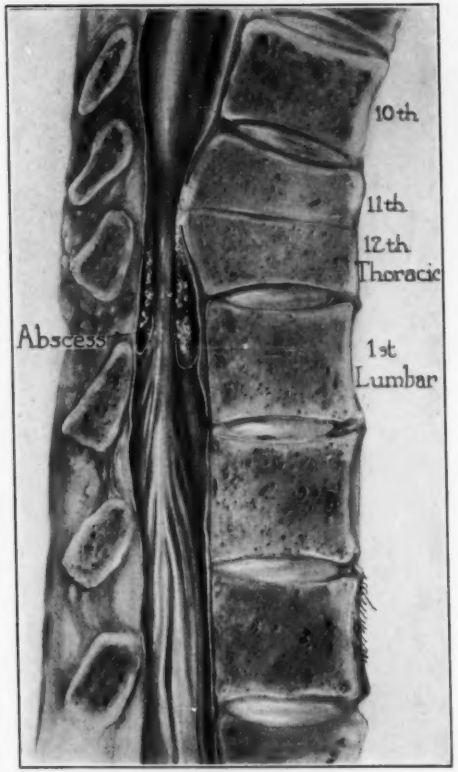

FIG. 4

Small, circumscribed abscess producing pressure paralysis in the cauda equina; tuberculous destruction of the eleventh dorsal joint.

FIG. 5

Intra-rachidian abscess in Pott's disease simulating external pachymeningitis. The fungosities are situated upon the external surface of the posterior common vertebral ligament which has been stripped from the vertebral bodies by an abscess. *From the collection of Drs. Etienne Sorrel and Mme. Sorrel-Dejerine.*

FIG. 6

Same as Fig. 5, showing complete integrity of the dura mater after the abscess wall of vertebral ligament has been removed. *Drs. Sorrel, Berck-Plage, France.*

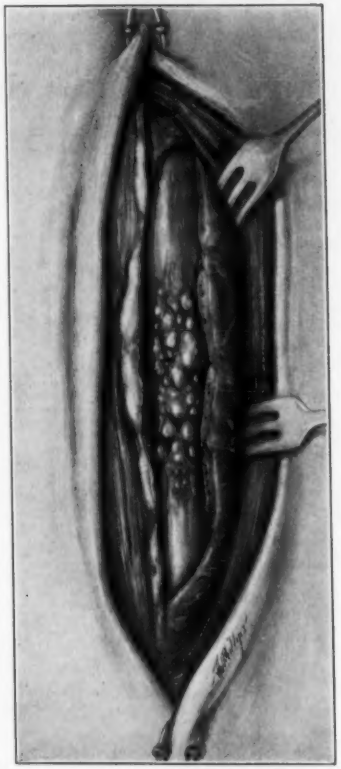

FIG. 7

Drawing after a hemilaminectomy, showing the appearance at operation of a section of spinal cord involved in chronic pachymeningitis with complete cord sclerosis and permanent suspension of all cord functions.

natural conservatism, and because of timidity in opening into these areas, we resorted to the Calot bed and strapped the lad down for three months. After this interval, Dr. Hunter of Tacoma, while treating the father, saw the boy and advised a laminectomy, which was allowed. Dr. Hunter found a very acute constriction of the cord, due entirely to the pressure of the angulation, which was extreme, as shown in Figure 3. There was no marked meningeal nor abscess involvement. After surgery, recovery was fairly rapid; walking was possible in seven months.

TYPE 3. PARALYSIS FROM ABSCESS PRESSURE. RECOVERABLE

Third, there is the most common curable condition of all, namely, paralysis from abscess pressure. In more than two-thirds of the palsies of Pott's disease, the paralysis is due to the encroachments of an intramural abscess that produces a suspension of cord function without cord destruction. Calvé[6] and Sorrel[7] claim that ninety per cent. of cases of this type recover in from one to three years, if properly treated with recumbency, heliotherapy, and good feeding. Recovery has been seen as late as six and eight years.

The pathology consists of vertebral body destruction with a thickening of the posterior (and sometimes anterior) common spinal ligaments, which peel away from the bodies of the vertebrae. A pouch is thereby formed that fills with pus under pressure (Fig. 4). This pouch may or may not surround the cord (Fig. 5). However, Ménard insists that this abscess is anteromedullary, while the Sorrel specimens tend to prove that the cord can be surrounded by an abscess and covered with a thick, fatty and ligamentous membrane, quite discrete of an oedematous or normal dura mater (Fig. 6).

The case below typifies this large class of abscess

FIG. 8

Medullary compression having produced chronic pachymeningitis and permanent paralysis. No abscess. Primary cause was the irritation of the vertebral sequestrae. *Collection Maritime Hospital, permission of Drs. Sorrel and Sorrel-Dejerine.*

meningitis with complete cord sclerosis and permanent suspension of all cord functions.

From the collection of Drs. Etienne Sorrel and Mme. Sorrel-Dejerine.

pressure palsies, although they usually appear earlier in the case history:

CASE 3. W. J., male, age ten. During the eighth year, while living in Pennsylvania, there developed a spinal tuberculosis of the fourth, fifth and sixth dorsal vertebrae. Was untreated for several months; then for a year was on the Bradford frame. In spite of recumbency patient developed a marked kyphosis and a large wandering psoas abscess. When first examined two sinuses were discharging; child weighed fifty-four pounds and was in poor general condition, on account of which he had been brought west. The main complaint was a beginning stiffness in both legs and sudden spasmodic contractures of the hamstring tendons at night. Symptoms were all progressive and soon were accompanied with anaesthesias below the knees. Family economic conditions forbade hospitalization, but recumbency on a frame was used at home. Probably rest was not forced and consistent. After two months' observation the right leg had become entirely paralyzed and senseless. Left leg was capable of some impaired motion, but progressively losing all function; and a painful hyperaesthesia had superseded the anaesthesia in the foot and calf. Abdominal reflexes were missing. Radiographically a massing of the fourth to the seventh dorsal vertebrae was shown, with a sharp angulation and some diminution of the neural canal. Spinal fluid was not examined. A diagnosis was made of cord pressure from an abscess ramifying from a psoas abscess. Patient was removed to hospital, given head and foot traction on a gas-pipe frame, but in spite of such active treatment conditions continued for three more months; the paralysis extended to a flaccid palsy of both legs. Disappointed with ordinary extension, a winch used by Hoffa was employed. This apparatus was incorporated in plaster above and below the kyphos and daily tightened to increase the spinal extension. After several weeks of this double extension, improvement was noted. In five months he had so improved that he was removed to his home, and at the end of a year was pronounced paralysis-free.

TYPES OF PARALYSIS THAT DO NOT RECOVER

Any paralysis starting late in Pott's disease — say after the third year of the disease—, that is steady and progressive, that is incomplete and selective, is usually incurable.

TYPE 4. PARALYSIS FROM PACHYMENINGITIS. NOT RECOVERABLE

About twelve per cent. of the cases of Pott's paralysis are not so fortunate. Late in the disease a steady progressive palsy creeps on that often takes months to reach its maximum. This paralysis is usually incomplete. Of the muscular systems, some are selected for blight and others are left with function. There is a dissimilarity of motor and sensory disturbance in the two limbs or the two sides of the body. Such cases of paralysis do not recover; the paralysis is due to a pachymeningitis in the different membranes surrounding the cord that eventually affect the afferent lines. The thickened membranes may be a primary source of pressure on the cord, permanently suspending its function (Fig. 7), or the meningitis of the dura may be secondary to the constant irritation of sequestrae forced backward from the vertebrae (Fig. 8).

The following case illustrates this pachymeningeal paralysis:

CASE 4. E. D., girl thirteen years. Spinal tuberculosis primary in the eighth and ninth dorsal vertebrae. Duration from onset thirty-six months. Destruction of the eighth dorsal well advanced at time of onset of paralysis. No evidence of local or psoas abscess. No evidence of bony pressure. Case had been treated partly by recumbent and partly by ambulatory methods. Upon entrance to the clinic, spasticities had caused much anxiety and were premonitory of a slow general paralysis below the cord level. Flexion of the left foot on the leg and action of the left tibialis anticus were still present. Gas-pipe extension and direct heliotherapy were immediately begun and used for the following eight months with little change in all fixed paralyses. Parents then demanded surgical intervention. A hemilaminectomy, doing the minimum of harm and affording an opportunity to view the coverings of the cord and the cord itself, was done; no abscess or bony sequestrae were present for a distance of three laminae above and two below the angle of the small kyphos; the dura was thickened and studded with greyish-white cauliflower vegetations, highly oedematous. The thickened membranes seemed to surround a slightly narrowed but otherwise normal cord. The report coming from the laboratory was "villous pachymeningitis" (Fig. 7). For a week following surgery there was a decrease in the spasticities and apparent improvement in the leg movement. Improvement was disappointingly transient, and patient returned to her former condition. At home just three months later, she developed tuberculous meningitis and died.

Cases of this type show the futility of surgery. Even though insisted upon, surgery too often can not be held guiltless. Pachymeningitis is a non-surgical condition, and surgery in attacking it probably lays open new areas for infection.

MIXED TYPES

All cases of Pott's paralysis are not pure single types. There are many cases of mixed and combined pathology with a consequent befogging of course and symptoms. This crossing of types makes difficult the securing of data regarding type frequency.

GENERAL CONSIDERATIONS

There seems to be little doubt but that the best general method of handling most of these palsies is the enforced conservative, or the old-fashioned orthopaedic method. Any case with a possible chance of recovery from the paralysis will do best under a method that takes off the vertical load, straightens out the kyphosis and provides rest.

Generally speaking all surgical procedures, as laminectomy, laminotomy[9], intra-spinous abscess drainage through the vertebral canal, or even costotransversectomy as described by Menard[10], are for the most part useless in ordinary hands. They are too often disastrous to patients and apt to discredit surgery. *The only cases that radical surgery can claim to benefit are those curable cases that fortunately improve in spite of surgery and would have done better if left alone in a good conservative environment.* Again it is often difficult to persuade patients and parents that the slow, discouraging lapse of months is the best assurance of final improvement in a day of surgical successes. Often repeated explanations and continual

reassurance are necessary to satisfy the minds of patients and compensate for apparent inaction in paralyses that seem stationary.

SUMMARY

1. Muscular paralysis under the proper treatment of spinal tuberculosis should be of rare occurrence.

2. Paralyses early in Pott's disease, sudden in onset, and complete in extent, due to the pressure of bone or abscess, or to simple oedemas, are favorable for recovery.

3. Paralyses appearing late in spinal tuberculosis that are slow, progressive, and incomplete, and that arise secondary to inoperable changes of pachymeningitis and to cord sclerosis, do not recover.

4. A palsy with marked spasticities, due to simple bony angulation, does exist and is the one form of paralysis that sometimes yields to surgical relief.

5. The treatment of the paralyses of Pott's disease, with the exception last mentioned, is more favorable under conservative than with radical measures.

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PRIMARY NERVE LESIONS IN INJURIES OF THE ELBOW AND WRIST*

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A vast literature has accumulated round the problems of nerve complications in the bone injuries of civil life, and it is proposed to confine the observations of this paper to the primary nerve lesions of elbow and wrist injuries. The investigation has been based on a series of 5,000 fractures and dislocations which were under treatment, mainly at the Liverpool Royal Infirmary, during a two-year period. Every case treated in these fracture clinics has a note dictated by the house surgeon on the first day of examination as to the presence or absence of an associated nerve injury, and this routine has not only made it easy to distinguish primary from secondary nerve palsies, but has shown a higher incidence of transitory primary lesions than is generally recognized.

DISLOCATIONS OF THE ELBOW

Amongst the 5,000 bone and joint injuries surveyed there were ninety-seven dislocations of the elbow which have been classified according to the type of displacement.

CLASSIFICATION OF 97 ELBOW DISLOCATIONS

Direction of Displacement	*Number of Cases*	PRIMARY NERVE PALSY *Ulnar*	*Median*	*Musculospiral*
Backwards	32	..	..	2
Back and outwards	29	..	1	..
Back and inwards	3	..	..	..
Outwards	16†	12	..	..
Inwards	2	..	..	..
Forwards (fractured olecranon)	2	..	..	..
Dislocation of head of radius	7	..	..	..
Direction unknown	6	1	..	..

†Internal epicondylar epiphysis in joint in 8 cases—all with ulnar palsy.

Two of the thirty-two cases of backward dislocation were complicated by a musculospiral palsy. In these cases recovery followed simple conservative treatment after reduction of the displacement, in one case in three and one-half weeks and in the other in three months. In one of the twenty-nine cases of dislocation backwards and outwards there had been traction on the median nerve over the lower end of the humerus with an incomplete palsy which recovered rapidly. In one other case a median palsy occurred, but here there was a dislocation of the elbow and of the carpal semilunar bone in the same arm, and the clinical features showed

*Based on a paper read before the American Orthopaedic Association on the occasion of its visit to Liverpool, July 1929.

DISLOCATION OF ELBOW WITH NERVE LESION

Ref. No.	*Age*	*Duration*	*Direction of Dislocation*	*Associated Fracture*	*Nerve Lesion*	*Treatment*	*End Result*
308	50	1 day	Backwards		Musculospiral primary palsy.	Manipulation. Palsy treated conservatively.	Normal. Recovered 3½ weeks.
709	17	3 weeks	Outwards	Epiphysis of epicondyle in joint.	Ulnar palsy.	Refused operation. Cuff and collar 4 weeks.	Flexion normal. Extension 10°. Osteo-arthritis. Palsy recovered.
837	23	1 day	Backwards	Coronoid.	Inner cord. Brachial plexus lesion.	Manipulative reduction.	Normal. Palsy due to cervical rib. Recovered.
1005	40	1 day	Outwards		Ulnar palsy.	Manipulation. Anterior transposition 6 months later.	Normal.
1660	21	1 day	Backwards		Primary musculospiral palsy.	Manipulative reduction.	Normal. Palsy recovered 3 months
1865	13	1 day	Outward subluxation	Epicondylar epiphysis in joint.	Primary ulnar palsy.	Operative replacement epiphysis. Neurolysis. Nerve replaced in groove.	Normal. Palsy recovered in 8 months.
2412	19	4 days	Backward and outward	Internal epicondyle.	Primary median palsy.	Manipulative reduction.	Palsy recovered 8 weeks. Extension limited 20°.
2458	13	1 day	Outward	Epicondylar epiphysis "in joint".	Primary ulnar.	Manipulative reduction. Epiphysis reduced spontaneously.	Normal, apart from "thickening" round epiphysis.
2929	12	6 months	Outward subluxation	Epicondylar epiphysis in joint.	Primary and secondary ulnar palsy.	Epiphysis excised. Anterior transposition ulnar nerve.	Extension limited 30°. Otherwise normal.
12552	51	6 months	Outward	Fracture internal epicondyle.	Ulnar palsy.	Anterior transposition nerve.	Extension limited 20°. Otherwise normal.
6749	14	9 months	Outward subluxation	Epicondylar epiphysis in joint.	Primary and secondary ulnar palsy.	Epiphysis had been excised 9 months ago. Nerve transposed.	Normal.
14077	15	2 days	Outward subluxation	Epicondylar epiphysis in joint.	Primary ulnar palsy.	Epiphysis repiaced and nerve transposed. (Nerve "kinked" towards and almost into joint.)	Normal.

DISLOCATION OF ELBOW WITH NERVE LESION (Cont.)

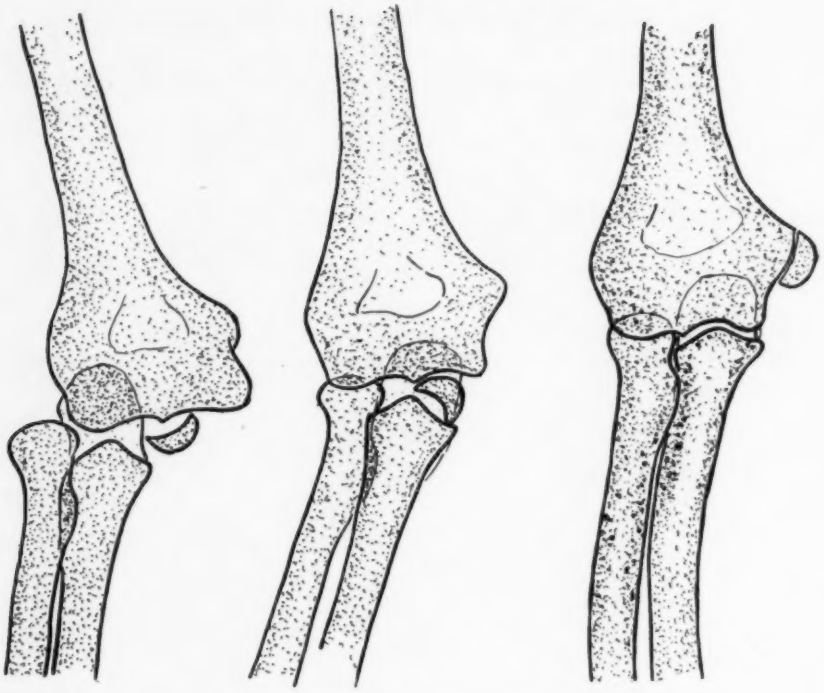
Ref. No.	*Age*	*Duration*	*Direction of Dislocation*	*Associated Fracture*	*Nerve Lesion*	*Treatment*	*End Result*
15376	48	1 day	Back and outward	Dislocation of semilunar and interphalangeal joint.	Primary median.	Manipulative reduction, elbow, wrist and finger.	Still under treatment.
B1052	57	1 day	Outward	Neck of radius with complete detachment of head.	Primary ulnar.	Manipulative reduction. Head of radius excised.	Extension 70°. Flexion full. Slight radio-ulnar grating. Palsy recovered.
B1214	51	6 months	Outward. Still slightly subluxated.		Ulnar palsy.	Anterior transposition.	Palsy recovered in 4 months.
B1227	29	1 day	Already reduced		Primary ulnar palsy.	Rest for 4 weeks.	Normal.
B1291	14	1 day	Outward	Epicondylar epiphysis in joint (after manipulation).	Primary ulnar palsy.	Manipulative reduction. Epicondyle replaced and nerve transposed on 4th day.	Normal.
B1693	13	10 days	Outward subluxation	Epicondylar epiphysis in joint.	Primary ulnar palsy.	Epicondyle replaced. Nerve transposed.	Normal.
P 434	14	7 days	Outward	Epiphysis of epicondyle separated.	Primary ulnar palsy.	Manipulative reduction.	Normal.

that the injury had been sustained at the level of the wrist and not at the elbow.

But the interesting observation is that of the sixteen cases in which there was a pure outward dislocation with no trace of backward displacement, there were no less than twelve with ulnar palsy, and these were the only cases of ulnar palsy in the whole series. It is quite clear that the primary ulnar palsy of elbow injuries has exactly the same pathogenesis as the delayed ulnar palsy associated with cubitus valgus in an ununited condylar fracture of the humerus. Owing to the fixation of the nerve in the postcondylar groove with its roof of fibrous tissue, the carrying outwards of the forearm into the valgus position produces a direct traction on the nerve trunk. If on the other hand the forearm is carried *backwards* and outwards, the roof of the postcondylar groove is torn, and the nerve, escaping backwards from its groove, gains free mobility and can now be displaced outwards without traction injury.

DISLOCATION OF ELBOW WITH DISPLACEMENT OF INTERNAL EPICONDYLAR EPIPHYSIS INTO JOINT

In about twenty-five per cent. of elbow dislocations there is an associated injury to the internal epicondyle, and in children it is the epiphysis



Initial condition. After manipulation. After operation.

FIG. 1

Dislocation of elbow with displacement of epiphysis of internal epicondyle into elbow joint and ulnar palsy. (Tracings from x-rays.)

of the epicondyle which is torn off by the aponeurotic common flexor origin. Being attached to the forearm bones, the epiphyseal fragment is not only displaced with them in similar direction and degree, but is accurately restored to its normal position when the displacement of the forearm bones is corrected. There is, however, one exception to this, for in pure outward dislocation of the elbow, the epiphysis can very easily become imprisoned in the inner half of the elbow joint during reduction (Fig. 1). It is also possible for the epiphysis to be displaced into the joint in the absence of a complete outward dislocation. By a fall on the outstretched hand the inner part of the joint may be sprung open sufficiently to produce a temporary cubitus valgus, to detach the epicondylar epiphysis, and to nip it between the joint surfaces as they snap together again (Fig. 2).

But whether the mechanism involved is of the first or of the second type, the fact that the epiphysis is imprisoned in the inner half of the joint proves that there has been a valgus strain—an outward displacement of the forearm bones— and, as one would expect, the condition is invariably associated with ulnar palsy. Eight cases of this type are included in the series, three with and five without complete dislocation, and in every case there was an incomplete ulnar palsy. The total number of such cases

traced in the literature is fourteen[1,2,3] and, with the exception of two reported by one author[4], there has invariably been an ulnar nerve lesion.

Platt[5,6] has suggested that in epicondylar injuries the ulnar palsy is produced by contusion of the nerve by direct injury. But an analysis of seventy-six cases of fracture of the internal epicondyle suggests that

SUPRACONDYLAR FRACTURES WITH NERVE LESIONS

Ref. No.	*Age*	*Duration*	*Direction of Displacement*	*Complications*	*Treatment*	*End Result*
217	13	1 day	Forward and outward	Primary ulnar palsy.	Manipulation. Splints in extension.	Normal.
278	7	2 days	Backward Outward	Slight secondary ulnar palsy (2nd week).	Manipulation 3 times. Cuff and collar 4½ weeks.	Normal.
430	9	4 months	Backward ++ Outward ++	Volkmann. Ulnar and median palsy.	Osteotomy. Neurolysis of median.	Flexion full. Extension 10°. Palsy recovered.
788	14	1 day	Backward ++ Slightly out.	Primary musculospiral palsy.	Manipulation. Palsy treated conservatively. 5 months.	Normal.
687	16	6 months	Outward ++	Secondary ulnar palsy.	Anterior transposition ulnar nerve. Fragments of bone excised.	Palsy recovered. Flexion 35°. Extension 15°.
1377	9	2 days	Forward +++ Outward + Rotation ++	Primary ulnar palsy.	Manipulation 4 times. Splints in extension 3 weeks. Exploration ulnar nerve and anterior transposition.	Palsy recovered. Slight forward tilt remains. Flexion full. Extension 40°. No other symptoms.
1920	9	8 weeks	Forward ++ Outward +	Primary ulnar palsy.	Manipulation twice failed. Open reduction. Over-reduced. Osteotomy 9 months later.	Normal.
B1075	12	3 weeks	Forward + Outward	Primary ulnar palsy.	Manipulation failed. Open reduction and exploration of nerve. Splints in extension 3 weeks. Sling 1 week.	Normal.
B1311	16	10 years	Outward. Cubitus valgus.	Delayed ulnar palsy.	Anterior transposition ulnar nerve.	Palsy recovered. Elbow *in statu quo*.
13624	12	3 days	Backward and outward. Comminuted.	Primary musculospiral palsy.	Manipulation twice. Neurolysis.	Flexion 60°. Extension 55°.
14414	9	2 days	Backward and outward. Rotation.	Primary ulnar palsy (after over-reduction).	Manipulation 3 times. Splints in extension 4 weeks.	Normal.

ulnar palsy is only common in epicondylar separations produced indirectly by valgus strain of the elbow in falls on the outstretched hand, and rarely arises in fractures due to direct trauma where there is no dislocation.

SEPARATION OF EPIPHYSIS AND FRACTURE OF INTERNAL EPICONDYLE—76 CASES

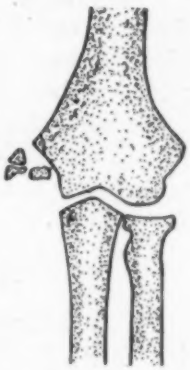
	Number of Cases	*Ulnar Palsy*
1. Due to Direct Injury (Blow, or fall on elbow)	36	none
2. Due to Indirect Injury (Fall on outstretched hand)		
a. No associated dislocation	13	2
b. With outward subluxation—epiphysis in joint	5	5
c. With outward dislocation	5	3
d. With dislocation other than outward	17	none

Epicondylar injuries are therefore divisible (Fig. 3) into two etiological and clinical groups: (1) the group due to direct trauma, which may vary from a simple crack to an extensively comminuted fracture, but in

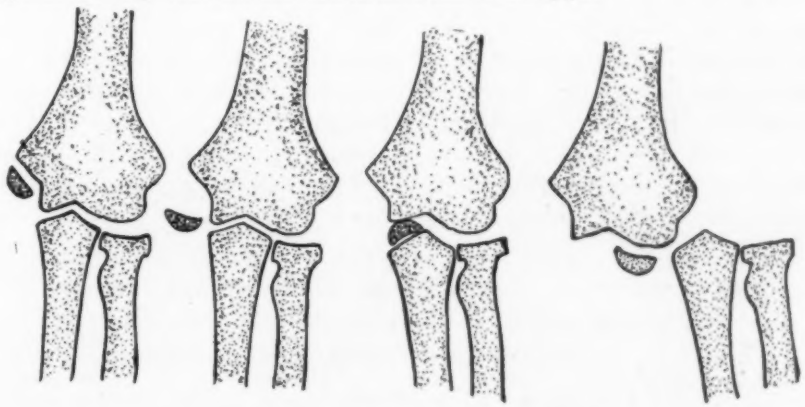
FIG. 2

Displacement of internal epicondylar epiphysis into elbow joint, without complete outward dislocation.

which, contrary to expectation, the nerve is rarely damaged; and (2) the group due to indirect trauma, where the epicondyle is torn off by muscular action. This second group comprises four types depending on the degree of trauma: (*a*) the mild strain producing slight separation of the epiphysis and no nerve injury; (*b*) the more severe strain, with displacement of the epiphysis down to the level of the joint and occasionally traction nerve injury (Fig. 4); (*c*) the actual springing open of the joint, so that the fragment slips in and nerve palsy is practically always present (Fig. 2); and (*d*) the continuance of the force sufficiently to dislocate the joint completely and inevitably to produce a nerve injury unless there is associated backward displacement (Fig. 1). Any of these types may occur primarily or, on the other hand, manipulation may convert the fourth into the third type.



Direct injury



Indirect injury (fall on outstretched hand)

FIG. 3

Diagram illustrating types of injury of the epiphysis of the internal epicondyle of the humerus.

When the epicondyle is in the joint, operative treatment is essential for two reasons. Unless the fragment of bone is removed from between the articular surfaces, limited movement and eventually osteo-arthritic changes are certain to arise. In Case 2929, after six months of conservative treatment elsewhere, the total movement was forty per cent. of normal and there were frequent attacks of pain. At operation the fragment was found firmly united to the coronoid and had to be chiselled away. In Case 709 where operation was refused, the final movement was fifty per cent. of normal, and marked osteo-arthritis is present eighteen months after the injury. But it is not sufficient merely to excise or to replace the fragment, because the displacement of the capsule of the joint with the epicondyle has produced traction on the mesentery of the ulnar nerve and

the nerve trunk is consequently twisted or kinked. It is usually sharply kinked outwards at the level of the joint, and may even be displaced into the joint itself[2]. Case 6749 was referred to the writer nine months after the fragment had been excised from the outer side of the joint, for some obscure reason, and the nerve had never been exposed. Although treatment had been continued for nine months, there was no recovery in the nerve paralysis. As a rule, the writer has performed an anterior transposition, but a simple neurolysis, with freeing of adhesions and replacement of the nerve in the postcondylar groove, may be sufficient in certain cases (Case 1865).

SUPRACONDYLAR FRACTURES OF THE HUMERUS

It is well recognized that in supracondylar fractures of the humerus, injudicious treatment may readily produce a secondary friction neuritis of the ulnar nerve. Primary ulnar palsy on the other hand is rarely found, and this is to be expected, since marked outward displacement is seldom present unless there is associated backward displacement. But a type of displacement is occasionally seen in supracondylar fractures which has no analogy in dislocations of the joint—marked outward and *forward* displacement of the distal fragment and forearm. This injury above all others should stretch the trunk of the ulnar nerve and, in fact, we find that in this series the only cases of supracondylar fracture with primary ulnar paralysis were examples of this injury (Figs. 6-A and 6-B).

CLASSIFICATION OF 87 SUPRACONDYLAR FRACTURES OF THE HUMERUS

(All cases are included, whether treated from the outset or not.)

Displacement of Distal Fragment	*Number of Cases*	PRIMARY NERVE LESIONS			SECONDARY NERVE LESIONS		
		Ulnar	*Median*	*Musculo-spiral*	*Ulnar*	*Median*	*Musculo-spiral*
Backwards	25	..	..	..	..	..	..
Back and outwards	16	1*	..	2	2	1	..
Outwards	4	..	..	..	2	..	..
Inwards	9	..	..	..	..	..	..
Forwards and inwards	4	..	..	..	..	..	..
Forwards and outwards	6	4	..	..	..	..	..
Slight or none	23	..	..	..	..	..	..

*See text. A primary backward displacement was overcorrected and converted into a forward displacement.

Of the six cases in which the small distal fragment was displaced forwards and outwards, four were complicated by ulnar paralysis. The only other case of primary ulnar palsy in the series is particularly instructive. When first seen there was backward and outward displacement and no nerve lesion (Fig. 7-A). Manipulative reduction was attempted and according to routine the case was seen at the following morning's fracture clinic, when the backward displacement was found to be incompletely corrected. There was still no nerve lesion and it was remanipulated. On the third morning, the x-ray showed overcorrection of the displacement

(Fig. 7-B). There was now forward and slight outward displacement *and the signs of incomplete ulnar palsy were present.* With a third manipulation perfect position was secured. The ulnar palsy recovered in five weeks and perfect function in the elbow and hand was secured (Fig. 7-C).

In this group of cases, instead of the nerve trunks being stretched over the rounded lower end of the humerus, traction is exerted over a sharp fractured margin, and nerve injury is likely to be more severe and exploration more often indicated. Unless there are early signs of recovery, there should be no hesitation in exploring a primary nerve lesion in a supracondylar fracture, particularly when the musculospiral or median trunks are damaged (See Cases 430, 687, 13674, and B.1075). Whereas in secondary lesions there is always the possibility of relieving the neuritis by eliminating the irritative factor, in primary lesions it is impossible to know whether the nerve block is simply "physiological" and due to temporary stretching, or whether there is an actual anatomical injury requiring neurolysis or suture.

FIG. 4

Separation of internal epicondylar epiphysis of humerus by muscular action (fall on outstretched hand), associated with stretching of ulnar nerve and palsy.

FRACTURE-DISLOCATIONS OF THE WRIST

One of the commonest deformities in wrist injuries is an outward displacement of the hand, which is a valgus deformity exactly analogous to cubitus valgus, and *a priori* it might be assumed that traction injuries of the ulnar nerve would be found with equal frequency in the two regions. But although at both levels the nerve lies to the inner side of the limb, and in close proximity to bone, there is really no comparison in the anatomical relationship, since at the wrist joint the nerve has practically no proximal anchorage, and has sufficiently free mobility in the forearm to escape traction injury.

But contusion injuries are much less rare, and the author[16] has reported three cases of primary ulnar palsy complicating severe displacements of the lower radial epiphysis. On clinical grounds, displacements

FIG. 5-A

Supracondylar fracture of humerus with backward and slight outward displacement and primary musculospiral palsy.

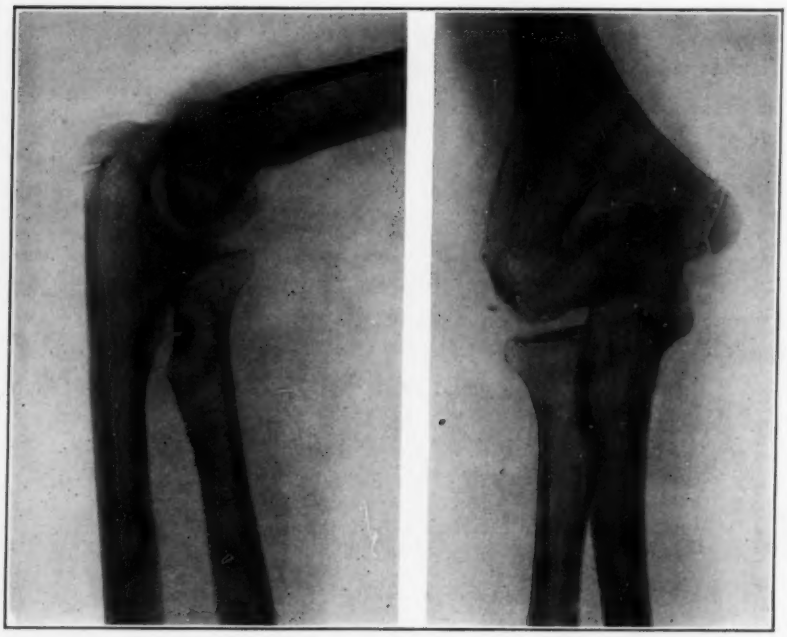


FIG. 5-B

Same case as Fig. 5-A after manipulative reduction and conservative treatment of nerve injury.

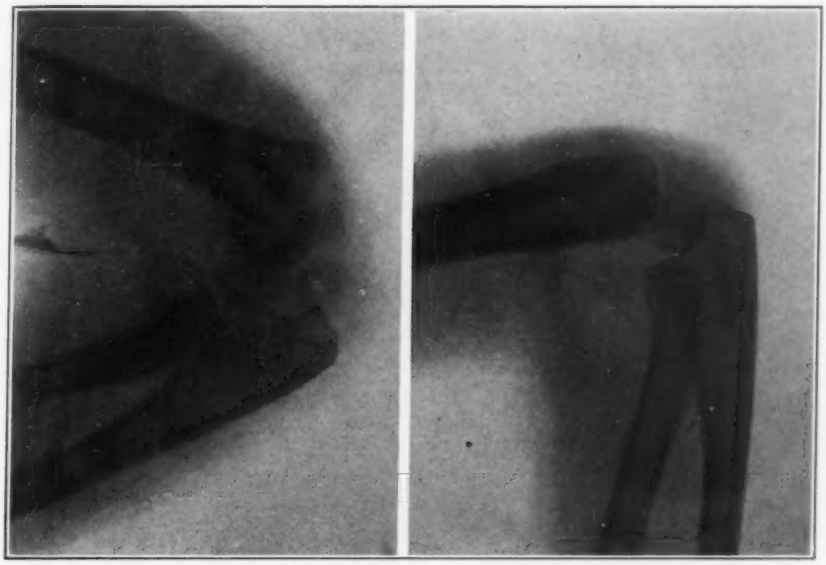


FIG. 6-A FIG. 6-B

Fig. 6-A. Supracondylar fracture of humerus with forward displacement of distal fragment and primary ulnar palsy.
Fig. 6-B. Same case as Fig. 6-A after manipulative reduction.

of the lower radial epiphysis should be divided into two groups, according to whether the epiphysis is torn away from the lower end of the ulna or remains attached to it. In the first case the epiphysis and hand are displaced in one direction and the radial diaphysis and ulna in another, the relationship of the diaphysis to the ulna being undisturbed. In the other case the epiphysis, the carpus, and the ulna remain attached and move in one direction, while the radial diaphysis moves in another (Fig. 8-A). This second type can accurately be described as a "displacement of the radial diaphysis", and it is easy to see from an x-ray film how the diaphysis in traveling obliquely forwards and inwards across the lower end of the ulna will impale the ulnar nerve on its sharp lower margin and produce a contusion injury. Fortunately, by the time the nerve trunk has been reached, most of the energy has been expended; and in none of the three cases described was exploration necessary, the palsy recovering completely after simple manipulative reduction of the displacement (Fig. 8-B).

The anatomical relationships of the median nerve at the wrist render it much more vulnerable; for unlike the ulnar nerve it lies beneath the anterior annular ligament, with restricted mobility and in close proximity to bone. Owing to the protection of the pronator quadratus, median palsy very rarely complicates Colles' fracture or backward displacement of the lower radial epiphysis; and if such injury does arise, the block is always incomplete, and no specific treatment is required, provided that the displacement is fully corrected. But it is when the nerve has passed beyond

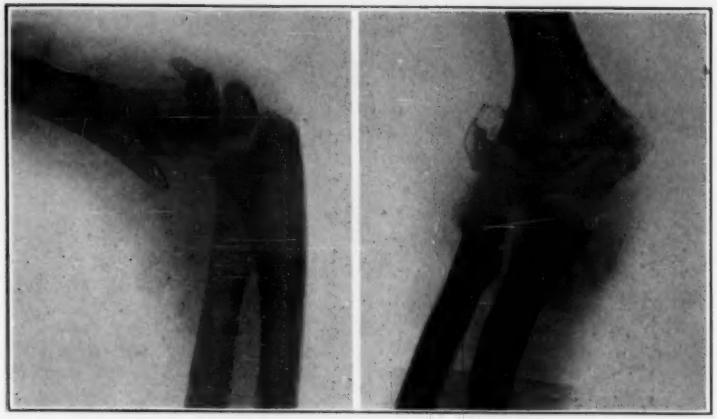


FIG. 7-A

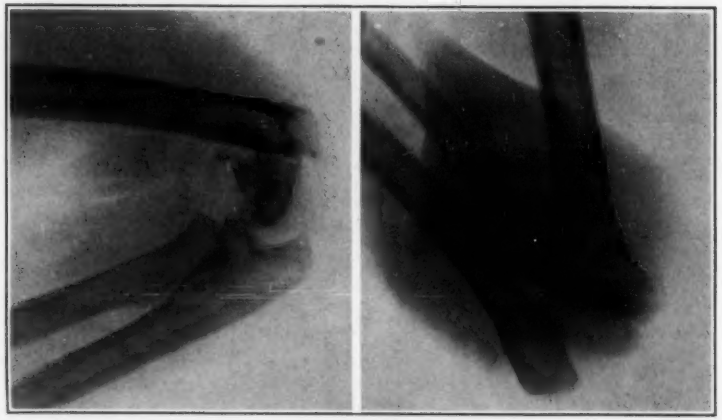


FIG. 7-B

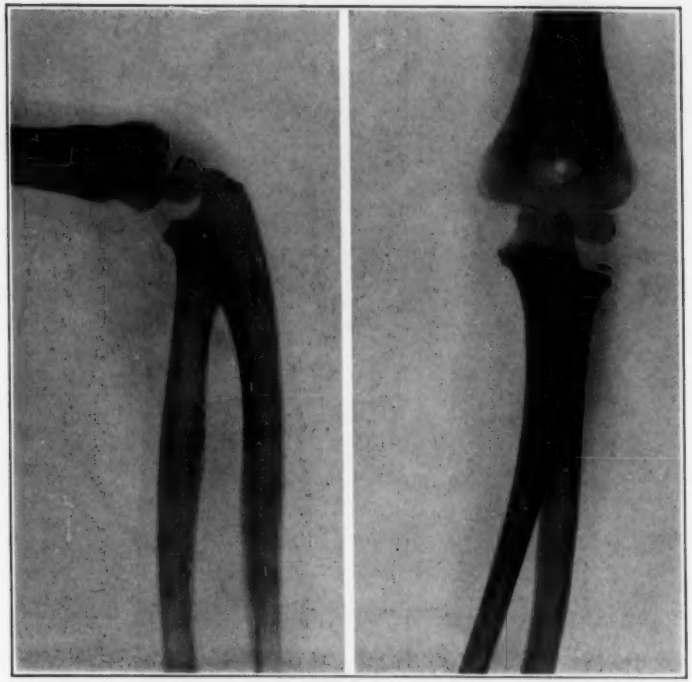


FIG. 7-C

Fig. 7-A. Supracondylar fracture of humerus with backward and outward displacement of distal fragment. At this stage there was no nerve lesion.

Fig. 7-B. Same case as Fig. 7-A after manipulation. The displacement has been overcorrected, the distal fragment is now carried forwards, and primary ulnar palsy has appeared.

Fig. 7-C. Same case as Figs. 7-A and 7-B. End result after further manipulation. Palsy recovered rapidly with conservative treatment.

Fig. 7-B

further manipulation. Palsy recovered rapidly with conservative treatment.

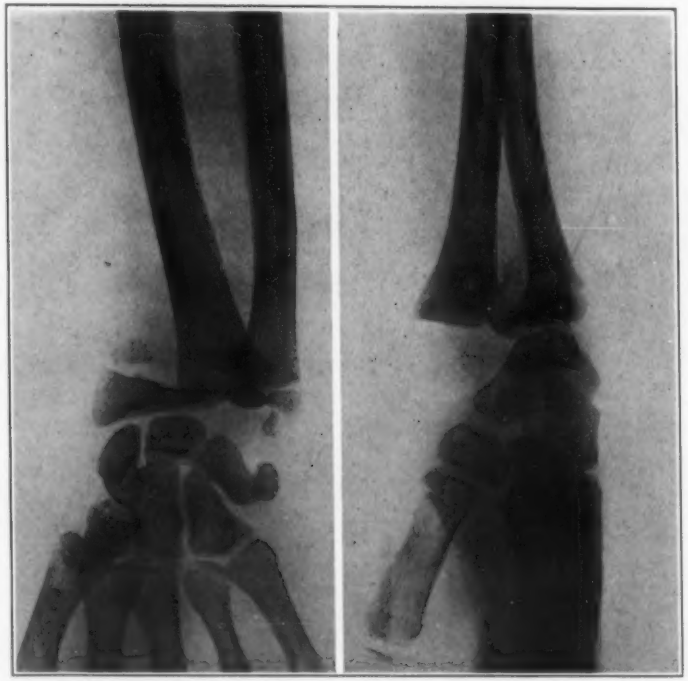


Fig. 8-A

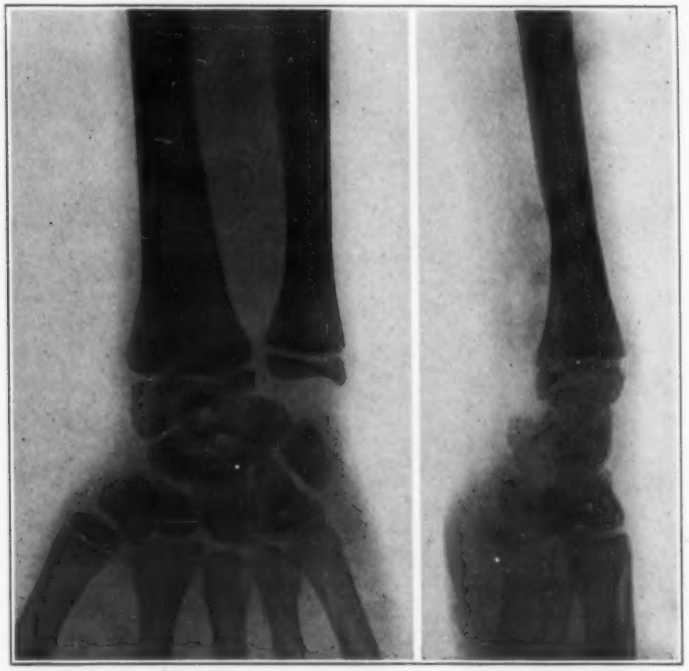


Fig. 8-B

Fig. 8-A. "Displacement of the radial diaphysis." A type of separation of the lower radial epiphysis, in which the epiphysis, carpus, and ulna maintain a normal relationship, but the lower end of the diaphysis is displaced forwards and inwards and damages the ulnar nerve.

Fig. 8-B. Same case as Fig. 8-A after manipulative reduction. It is seldom necessary to explore the ulnar nerve.

the lower border of the pronator muscle, on to the carpus, that it is most liable to injury.

DISLOCATION OF THE CARPAL SEMILUNAR BONE

Of the twenty cases of carpal semilunar dislocation reported, not one was a female patient, and all were over twenty years of age. Median palsy was found in exactly half of the cases, and there can be no doubt that the lesion is due to cramming of the displaced bone into a confined space already fully occupied by the nerve trunk and flexor tendons. This also accounts for the diagnostic physical sign of immobility of the semiflexed fingers.

It is the treatment of this injury in relation to nerve palsy which is of particular interest, and it will be recognized that treatment must have for its three primary objects: (*a*) the relief of nerve injury, (*b*) the unlocking of tendon-bound fingers, and (*c*) the prevention of arthritis of the wrist. These objects can readily be attained by excision of the displaced bone, but ideal treatment must go further than this and must guarantee perfect recovery of wrist movement and perfect recovery of strength.

Summary of 20 cases of Carpal Semilunar Dislocation

Treated by manipulative reduction....7 cases.
Treated by operative reduction.....4 cases.
Treated by excision (4 elsewhere).....7 cases.
No treatment given.....2 cases.

Result of Excision. The results of excision of the bone are amazingly good, having regard to the mutilation involved; but it is the writer's contention that instead of feeling gratified that such results are better than would be expected, we should be disappointed in that they fall so far short of normal. Seven cases of excision of the bone are recorded; in four the treatment was carried out elsewhere, the patients having wandered on to

DISLOCATION OF CARPAL SEMILUNAR

Ref. No.	*Sex*	*Age*	*Duration*	*Associated Fracture*	*Nerve Lesion*	*Treatment*	*End Result*
198	M.	20	1 day	Cuneiform. Both styloids.	Median.	Manipulative reduction.	Normal.
317	M.	30	3 days			Manipulative reduction.	Normal.
903	M.	21	2 days	Cuneiform chip off scaphoid.		Manipulative reduction.	Normal.
13075	M.	50	1 day	Chip off cuneiform.	Median.	Manipulative reduction.	Slight "click" occasionally. Otherwise normal.
2914	M.	30	2 days	Barton's fracture.	Median.	Manipulative reduction.	Dorsiflexion 75°. Otherwise normal.

DISLOCATION OF CARPAL SEMILUNAR (Cont.)

Ref. No.	*Sex*	*Age*	*Duration*	*Associated Fracture*	*Nerve Lesion*	*Treatment*	*End Result*
14143	M.	31	11 days			Manipulative reduction.	Normal.
15326	M.	48	2 days	Barton's fracture, also dislocation of elbow and finger.	Median.	Manipulative reduction.	Still under treatment, with limited dorsiflexion.
2155	M.	48	4 weeks	Os magnum.		Open reduction.	Dorsiflexion 60°. Palmarflexion 60° in 3 months. Not traced since.
2189	M.	30	4 weeks	Ulnar styloid.	Median.	Open reduction.	Normal.
4121	M.	26	6 weeks	Dislocation of whole scaphoid.	Median.	Open reduction of scaphoid and semilunar.	Normal.
B951	M.	39	5 weeks	Cuneiform.		Open reduction.	Dorsiflexion normal. Palmarflexion 60°.
15	M.	50	3 months	Cuneiform.	Median.	Excision of semilunar.	Dorsiflexion 50°. Palmarflexion 60°. Fairly good power.
1589	M.	48	5 months	Comminuted lower end of radius.	Median.	Excision of scaphoid and semilunar.	Dorsiflexion 70°. Palmarflexion 20°. Radial deviation of hand.
1901	M.	32	6 weeks	Waist of scaphoid.	Median.	Excision of semilunar and half of scaphoid.	Dorsiflexion 30°. Palmarflexion 45°. Weak.
13377	M.	21	Treated elsewhere			Excision of semilunar and half of scaphoid.	Subluxation of wrist and osteo-arthritis. Dorsiflexion 40°. Palmarflexion 50°.
B434	M.	37	Treated elsewhere		Median.	Excision of semilunar.	Dorsiflexion 60°. Palmarflexion 30°.
B639	M.	29	Treated elsewhere.			Excision of semilunar and half of scaphoid.	Subluxation of wrist and osteo-arthritis. Dorsiflexion 20°. Palmarflexion 15°. Weak and painful.
B2076	M.	30	Treated elsewhere.			Excision of semilunar.	Dorsiflexion 70°. Palmarflexion 70°. No pain. Slightly weak.
13206	M.	62	4 months	Waist of scaphoid.		Treatment refused.	Dorsiflexion 30°. Palmarflexion 20°. Fingers 80% normal movement.
13230	M.	51	"years"			Nil.	Dorsiflexion 70°. Palmarflexion 30°. Finger movements normal.

our clinics in the hope of securing further improvement. The average range of movement is sixty per cent. of normal, and strength is correspondingly impaired. Results are particularly poor when the semilunar and half of the scaphoid were excised, because of outward subluxation of the wrist with impingement of the remaining half of the scaphoid; and arthritic change is liable to remain permanently. Similar results have frequently been reported[9,10,11].

On the other hand the only method of manipulative reduction adequately described in the literature is that of Stern[7], in which the Thomas' wrench is used to lever the bone back into position. Between the front blade of the wrench and the semilunar lies the median nerve, and by such a method further compression of the already damaged nerve appears inevitable.

Method of Manipulative Reduction. Over two years ago the writer evolved a modified method[16] in which the whole manipulation is performed manually (Fig. 9); no leverage is employed and there is no necessity for instruments, wedges, or a wrench. With the wrist fully dorsiflexed, the thumb of one hand is placed over the front of the bone to steady it and to limit its forward rotation. With the other hand the manipulator grips the patient round the fingers, exerts strong traction to pull the os magnum away from the radius, and then, maintaining the traction, the wrist is slowly palmarflexed, so that the os magnum glides round the back of the semilunar into its cup. The manoeuver, which is rather similar to a method described by Delbet[8], is carried out in the x-ray room and reduction immediately confirmed by radiology. Finger movements and flexion movements of the wrist are commenced at once and, provided that dorsiflexion is avoided for seven days, no further immobilization is required.

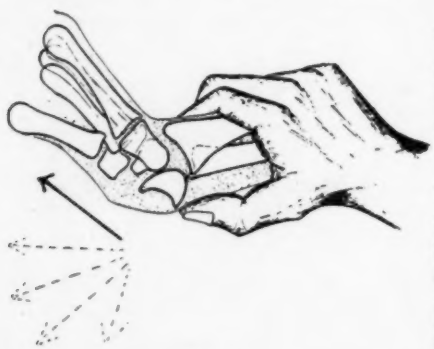


FIG. 9

A suggested method of manipulative reduction which was successful in seven consecutive cases of less than one week's duration. One thumb is placed over the semilunar to steady it. The carpus is then dorsiflexed, traction applied, and slowly palmarflexed. (Courtesy of the *Proceedings of the Royal Society of Medicine.*)

The series recorded includes seven cases of recent dislocation, and in every case the manoeuver was completely successful. One dislocation reduced by our house surgeon was of eleven days' duration (Figs. 10-A and 10-B). The results are eminently satisfactory and, unless the condition is complicated by a marginal fracture of the radius, patients make a complete and perfect recovery in about five weeks, securing a wrist which as a rule is quite indistinguishable from normal.

After ten days or a fortnight it is impossible to reduce the dislocation by manipulation, since the organizing serous exudate glues the bones

FIG. 10-A

Dislocation of the carpal semilunar bone after unsuccessful attempt at reduction.

together, and the head of the os magnum becomes adherent to the posterior capsule and to the back of the other carpal bones and radius. Is excision of the bone now justified? The writer's opinion is that it would be as reasonable to suggest excision of a four-weeks-old dislocation of the hip. There are two reasons why the result of operative reduction of the dislocated semilunar have hitherto been indifferent. In the first place, any attempt to reduce the bone through the same anterior incision used for removing it[12,13,14] must fail. Not only is the field of activity rigidly limited, but it is the head of the os magnum which requires mobilization and not the semilunar. In the manipulative manoeuver described the semilunar itself plays a purely passive rôle, and it is the os magnum which is pulled round into the semilunar. Secondly, open exposure of the bones has tempted operators to insert levers into the joint by which to assist the reduction. Any trauma, however slight, will impair the ultimate range of

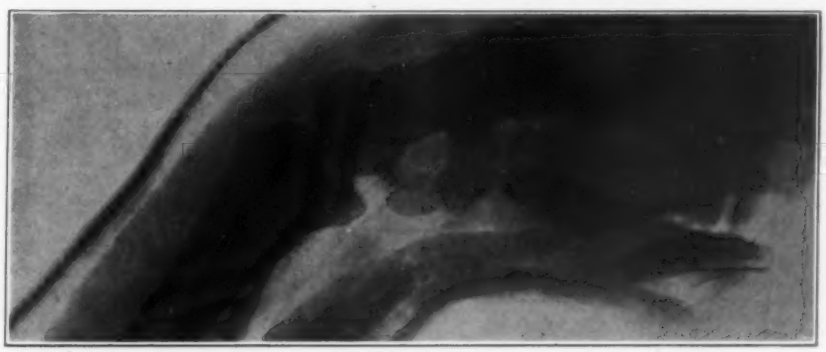


FIG. 10-B

Dislocation of the carpal semilunar bone after successful attempt at manipulative reduction by the method described. The manoeuver is carried out under full ether anaesthesia in the x-ray room, and lateral views taken after each attempt at reduction until successful.

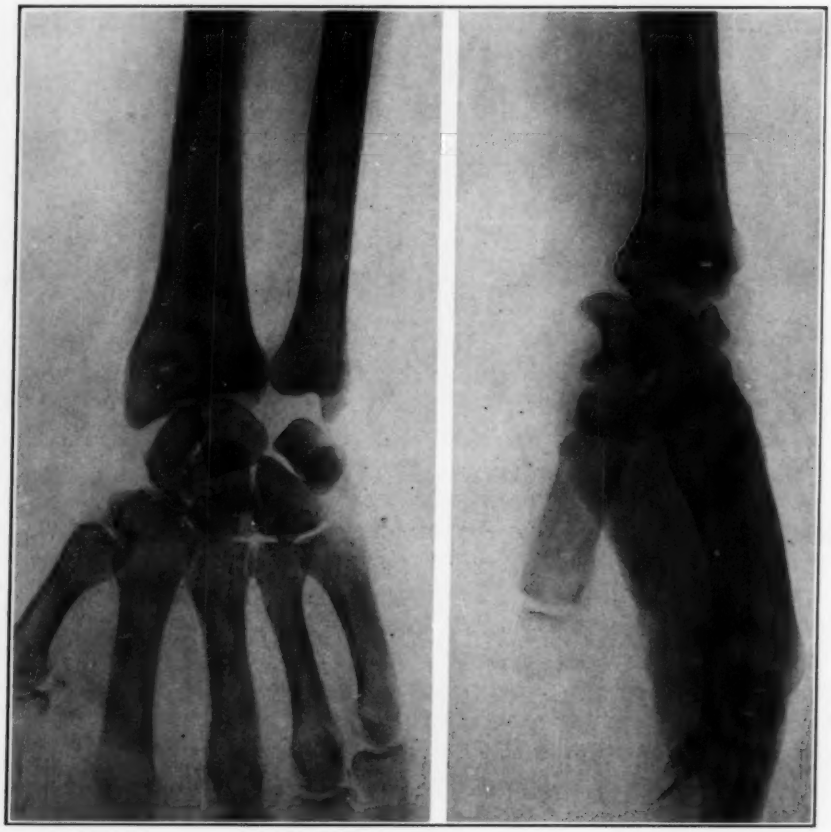


FIG. 11-A

Dislocation of the carpal semilunar bone with median palsy (four weeks' duration). Attempted manipulative reduction failed.

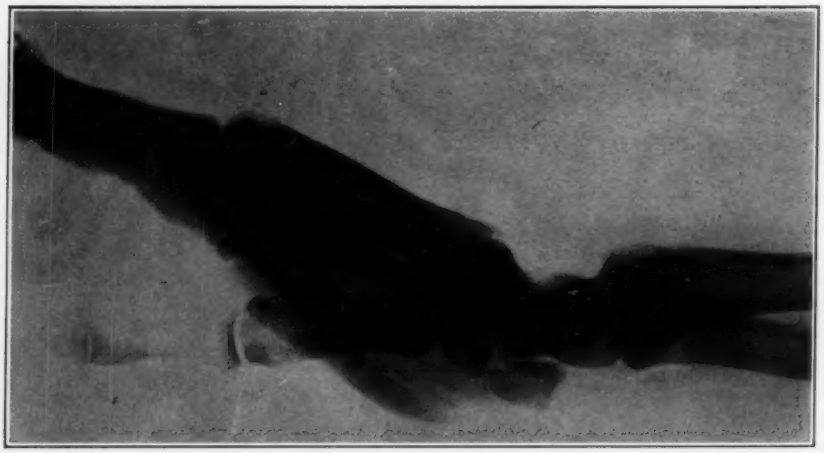


FIG. 11-B

Same case as Fig. 11-A after operative reduction by the method described. Apart from the scar, the wrist and hand are indistinguishable from normal.

movement, and tend to produce arthritic changes. This will account for the fact that in practically every recorded case of operative reduction the author has stated that the results are inferior to those of excision[15].

Method of Operative Reduction.[16] A two-inch incision over the back of the wrist is made in the line of the third finger. After retracting the tendons, the posterior capsule of the joint is carefully dissected off the head of the os magnum, and all adhesions are divided so that each of the carpal bones, and particularly the os magnum, has gained considerable mobility. Instruments are now laid aside, and the manipulative manoeuver described is carried out. If the duration of dislocation is less than seven or eight weeks, the bone clicks up into view with the greatest facility (Figs. 11-A and 11-B).

Four such cases are described and the figures show that, if it is possible to replace the bone without trauma to the joint, the results are very much superior to those of excision, and in fact fall very little short of the results of manipulative reduction.

But a method of operative reduction which depends on the use of levers between the glistening articular surfaces is to be condemned. The penalty of stiffness and arthritis is so certain that it would be better to admit defeat at once and to excise the bone.

CONCLUSIONS

1. Primary ulnar palsy in elbow injuries has the same pathogenesis as delayed ulnar palsy, in that it is produced by traction in cubitus valgus deformity.

a. It is relatively frequent in *outward* dislocation but not in backward and outward dislocations. It is most common in outward dislocation with displacement of the internal epicondylar epiphysis into the joint, because in addition to having been stretched, the nerve is now kinked or twisted at the joint level.

b. Injuries of the internal epicondyle are only associated with primary ulnar palsy when they have been produced indirectly by traction. Contusion injury is rare.

c. In supracondylar fractures, forward and outward displacement of the distal fragment is necessary for primary ulnar palsy to arise by traction over the fractured margin.

2. Primary musculospiral and median palsies in elbow injuries are due to traction in backward displacements. They are not serious in backward dislocations, but frequently require exploration in supracondylar fractures.

3. Primary ulnar palsy in wrist injuries rarely arises by traction, because the nerve has free mobility, but sometimes complicates severe displacements of the lower radial epiphysis when the injury is due to contusion by the radial diaphysis.

4. Primary median palsy in wrist injuries is rarely due to fractures of the lower end of the radius, because the nerve is protected by the pronator quadratus, but is frequently due to forward dislocation of the carpal semilunar bone.

Dislocations of the semilunar seen within seven days should be reduced by manual, but not by instrumental manipulation; if seen within eight weeks, they should be reduced by a non-traumatizing operation; if not seen until later than this, the bone should be excised.

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SOLITARY BONE CYSTS OF LONG DURATION

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The present knowledge of the pathology of solitary bone cysts is based upon studies of cases several months to several years in duration. The literature contains but very few reported cases of many years' standing and in not all of these were thorough histopathological studies made.

By way of introduction to the following case reports a brief review of the pathology of solitary bone cysts may be presented: Solitary bone cysts occur primarily in patients under twenty. They develop most frequently in the metaphyseal regions of the long bones, where growth is most marked,—*i.e.*, upper portion of tibia, upper portion of humerus, and femur. Other bones may be involved. They are usually unilocular but not rarely multilocular.

When seen by the clinician the cysts usually involve most of the width of the shaft and have expanded to decrease the thickness of overlying cortical bone. Pathological fracture, a result of this erosion of cortex, is the symptom for which medical consultation is most frequently sought. Swelling is present in a minority of cases and yet this may be pronounced without history of pathological fracture. The cortical bone overlying the cyst may be so thin as to give a parchment creptitation on palpation. Periosteal bone formation is usually slight and sometimes is absent.

The cysts usually contain clear yellow or brownish fluid and are often partially filled by coarse, soft, red-brown granulations loosely attached to the lining. In most instances the cyst is lined by a definite fibrous membrane that may easily be peeled away. Not rarely this lining is absent in much of the extent of the cyst wall and eroded where bone borders on the cavity.

Microscopically the granulations are composed of immature fibrous tissue in which are small thin-walled blood vessels and capillaries, and in which are scattered areas of old and recent hemorrhage. The fibrous membrane lining the cysts is of similar appearance. In cysts of long standing the granulations within the cavity are few or may be absent, and the lining is composed of closely packed bundles of collagen fibers between which are mature fibroblasts.

In cysts of comparatively recent development the granulations and lining are extensively infiltrated by lymphocytes, plasma cells, endothelial leucocytes (many of which may contain decomposed blood pigment), polymorphonuclear leucocytes, and giant cells of the foreign-body type. In some cases the latter may be so numerous as to lead to the diagnosis

of giant-cell tumor. In cysts of long standing the leucocytic and giant-cell infiltration is less pronounced.

In the majority of cases immediately surrounding the cyst lining there is a zone of fibrous marrow, but not infrequently fatty or cellular marrow may be present instead. The bone surrounding the cyst cavity exhibits regions of lacunar absorption, alternating with areas of osteoid tissue which may show calcification and new bone formation. Rarely there are small islets of cartilage in this region also.

CASE REPORTS

A few reports of solitary bone cysts of long duration are found in the literature:

Körte[1]. Female, age twenty-nine, with history of traumatic fracture of upper portion of left femur eighteen years previously, following which pain and swelling persisted. Recent fall caused acute exacerbation of pain. Left femur was shortened eleven centimeters. There was a painful, rather soft swelling and muscular spasm of left thigh. Operation and subsequently autopsy revealed large multilocular cyst with yellow fluid contents and smooth wall. Microscopically the lining was found to consist of dense fibrous tissue in places not unlike fibrocartilage.

Elmslie[2]. Female, age forty-two, exhibited shortening and outward bowing of right thigh and swelling about hip. Over a period of twenty-seven years this deformity had gradually developed. Roentgenogram showed large multilocular cystic cavity involving head, neck, trochanteric and subtrochanteric regions of femur. Histopathological study was not possible because operation was refused.

Elmslie[2]. Female, age thirty-four. Pathologic fracture eighteen, four, and one years previously in lower portion of left femur. Non-union after last fracture. Roentgenograms revealed a large solitary bone cyst at fracture site. At operation a clear fluid content was found. No histopathological study made or mention of cyst lining.

Delchef[3]. Male, age sixty-four. At age of thirteen received severe contusion of upper portion of right tibia. A few days later a fusiform swelling developed which was incised and drained. The swelling had persisted since then, but became painful only a few weeks previous to examination by the author. At this time palpation revealed a parchment crepitation. Roentgenograms showed a large, thin-walled, multilocular cyst in the upper end of the tibia, which at operation was found to contain yellow fluid. The cyst was lined by a fibrous membrane which was easily peeled away. No histopathological study.

The following case is placed on record because it is an instance of solitary bone cyst in which symptoms were present for thirty-eight years, and in which at operation there were unusual pathological findings:

M.S., white, male, peddler, fifty-eight years of age, admitted to the University Clinics February 27, 1929, gave the following history: At age of fourteen, while chopping

wood, a flying fragment struck flexor surface of left arm above elbow joint. Following this the arm remained swollen and somewhat tender for a year. Since the accident patient states that this extremity "never has been strong". Two years prior to admission dorsum of both hands became swollen and slightly tender, and knee and ankle joints were painful at times. This passed away, however, leaving only some limitation of motion in the right wrist with pain on extreme movements. The left elbow subsequently became swollen but not tender, and similar swelling developed in both ankles with limitation of motion. When the elbow was actively or passively moved a grating sensation could be heard and felt. Knees and ankles were again painful.

Past personal history irrelevant except that patient stated he had gonorrhoea and soft and hard chancre thirty years ago. No treatment received. Family history irrelevant.

The salient features on physical examination were: (1) Fusiform swelling of shaft of humerus about left elbow with slight swelling and a grating sensation in joint on passive motion. When the bones on each side of the elbow joint were firmly grasped, a sidewise motion could be demonstrated. (2) Painless swelling on dorsum of both hands. On medial aspect of right wrist there was a firm, bony, painless protuberance. (3) Swelling and pitting oedema about both ankles. Subcutaneous veins distended. Limitation of motion in ankle joints. (4) Fluid in both knee joints, more marked in left. Extreme motion of these was painful. On aspiration thirty cubic centimeters of yellow fluid was withdrawn from left knee, none obtained from right.

Temperature, pulse, and respiration normal. Erythrocytes 4,500,000, leucocytes 11,700, hemoglobin eighty per cent. (Talquist). Urine negative. Wassermann and Kahn negative. Blood chemistry normal. (Blood calcium 8.1 mg. per 100 cc. of blood.)

Roentgenograms showed extensive osteo-arthritis of left elbow and both wrist joints with crater-like erosion of articular surfaces. There was a spindle-shaped enlargement of the lower two-fifths of the diaphysis of the left humerus, in the interior of which was an oval area of reduced density bordered in almost its entire extent by a narrow cortex casting a dense shadow. There was a zone of cancellous bone about two and six-tenths centimeters wide between this and the expanded narrow cortex of the region (Fig. 1). There was also cystic erosion of the surface of the right os calcis and wrist joints (Fig. 2).

Operation was decided upon in order to determine whether or not there was an etiologic relationship between the bone cyst and the subsequently developing chronic arthritis, both of which might be of bacterial origin; also the regeneration following curettage of the cyst might strengthen it against pathological fracture.

Operation March 9, 1929. Ethylene anaesthesia. (Dr. D. B. Phemister)

(1) Biopsy, left elbow joint. An incision was made over the dorsum of the head of the left radius. A villous arthritis was found. Two small tags of synovial lining were excised for bacteriological and pathological examinations.

(2) Curettage of bone cyst. An incision twelve centimeters long was made over the posterolateral side of the lower portion of the left humerus beginning five centimeters above the elbow. The triceps was retracted and a spindle-shaped swelling of the humerus ten centimeters long exposed, over which the bony surface appeared slightly roughened. An oval window eight centimeters long was excised, passing through a thin outer cortex, a spongy layer, and an inner cortex exposing an oval cavity six centimeters long by two and five-tenths centimeters in diameter. This cavity was filled with brownish fluid, not under pressure, and in which were suspended many small shining cholesterol crystals. Furthermore, within the cavity there were several rounded, grayish, fatty masses, loosely attached to the cyst wall. The cyst was lined by a fibrous membrane closely associated with which was a gray calcareous shell, apparently forming also a continuous wall about the cavity. The fibrous and calcified lining, as well as the other contents of the cyst cavity, were removed by curettage. The cavity was then swabbed out with tincture of iodin and allowed to fill with blood. Wound closed without drainage. Convalescence was uneventful.

The patient was last seen June 4, 1929. General condition was good except for some pain in ankles. The patient stated that the left arm "feels stronger than ever before". Roentgenograms showed extensive bone repair at seat of the old bone cyst.

Bacteriological Studies. Small fragments of synovial lining from elbow and cyst lining and contents were ground in sand under carefully controlled aseptic conditions and the material thus obtained cultured in Rosenow's brain broth, ascites broth, paraffin-covered blood agar plates, and aerobic blood agar plates. After three weeks' incubation all cultures remained sterile.

Cultures of fluid removed from left knee joint were likewise sterile.

Microscopic Studies. Smears of the fluid from the cyst showed large numbers of cholesterol crystals. Fragments of bone overlying the cyst, cyst lining, and contents were fixed in alcohol-formol solution (10 per cent. formol in 95 per cent. alcohol), decalcified, and embedded in celloidin. Sections approximately twenty microns in thickness were cut, stained by Erlich's hematoxylin and eosin, and mounted in the usual manner.

The cortical bone and periosteum were found to be essentially negative except for osteoporosis and occasional evidence of lacunar absorption as shown by one or two foreign-body giant cells directly applied to bony lamellae. Between the cortex and cyst lining there is a zone of cancellous bone in which the lamellae are widely separated by spaces filled with fatty marrow.

The cyst lining varies from one-tenth to two millimeters in thickness. It consists of a membrane composed of rather closely packed bundles of collagen fibers, between which are small mature or slightly enlarged fibroblasts. Within this membrane is a wide dense band of calcareous deposit, which, however, in places is absent. Under high magnification this appears to be composed of closely packed, thin lamellae and granules of different sizes. In general it exhibits no cellular organization, but in three places in the sections examined there are small areas of beginning ossification. The calcareous band varies in thickness, in some areas being nearly as wide as the fibrous membrane within which it is included and elsewhere being either quite narrow or, rarely, absent.

The lining membrane also exhibits moderate diffuse infiltration by various types of leucocytes, mainly lymphocytes, plasma cells, some polymorphonuclear leucocytes and endothelial leucocytes (a number of which contain brown pigment) and an occasional giant cell of the foreign-body type. Bordering the external margin of the cyst lining and parallel to it are narrow elongated lamellae of bone alternating with areas of fatty and cellular marrow. The latter are by no means typical hematopoiectic marrow, but resemble more closely large dense foci of leucocytes of various types, including immature cells.

The solid portion of cyst contents consists of eosinophilic, finely granular, and fibrillar material, throughout which are scattered numerous typical cholesterol slits and leucocytes.

Sections through synovia of the left elbow joint show thickening by fibrous tissue proliferation, extensive leucocytic infiltration, and coarse villi. No foreign-body giant cells or brown pigment containing phagocytic cells are seen.

SYMPTOMATOLOGY AND DIAGNOSIS

The symptomatology of solitary bone cysts of long standing is such as to be almost pathognomonic. The duration of the complaints over a period of many years immediately rules out malignant neoplasm. The repeated pathologic fractures in the same location with progressive deformity, rheumatic pains, sense of weakness in the extremity involved, and occasionally parchment crepitation of the cortical bone, present a clinical picture that hardly admits of other diagnosis. On the other hand, pains at intervals and a sense of weakness in the extremity may be the only symptoms presented. Roentgenograms afford additional con-

FIG. 1

M.S. Solitary bone cyst, lower portion of shaft of left humerus. Cortex slightly thinned. *a*. Zone of cancellous bone about cyst cavity. *b*. Calcareous shell in cyst lining. *c*. Arthritic changes in elbow joint.

FIG. 2

M.S. Roentgenogram of left hand and wrist. *a*. Tufting of phalanges. *b*. Marked arthritic changes in left wrist joint.

FIG. 3

M.S. Lower end of left humerus sixteen weeks after curettage of bone cyst *a*. Window through cortex made at operation. *b*. Fragment of calcareous shell of cyst lining. Outlines of cyst cavity not visible and appearance of roentgenograms suggests filling with cancellous bone.

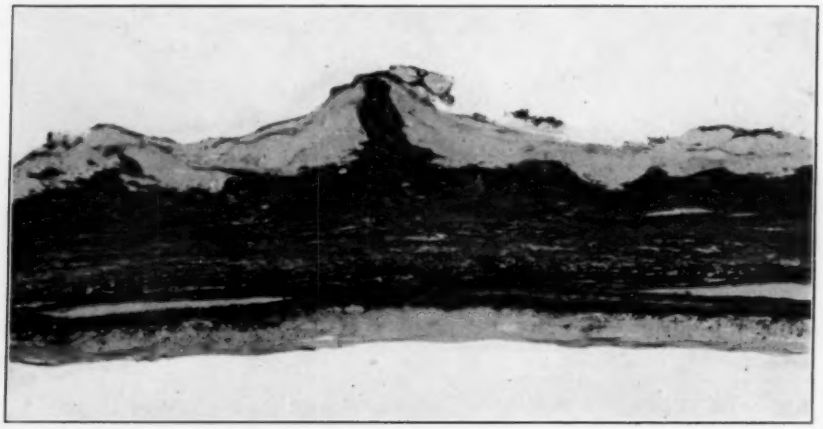

FIG. 4

×70. Section through calcareous shell in fibrous lining of bone cyst. Inferior margin borders cyst cavity. Note absence of leucocytic infiltration.

firmatory evidence. The only other lesion that perhaps may be suspected is giant-cell tumor. In these cases a pathological fracture resulting in a tear of the periosteal covering would permit the lesion to extensively invade surrounding tissue. Furthermore, a solitary bone cyst may not attain a great size, although it may be of many years' standing (Delchef's case and the writer's case reported above), while a giant-cell tumor of as long duration would exhibit considerable proportions.

TREATMENT

The treatment of solitary bone cysts of long duration is essentially the same as for more recent cases, although operation may not be indicated because of the fact that the lesion becomes quiescent or heals spontaneously. In this case the lesion was quiescent and the only therapeutic benefit coming from the operation was regenerative strengthening of the bone against the possibility of pathological fracture. Since the benign nature of these lesions has become generally recognized the accepted treatment is evacuation of the fluid and curettage of the lining and contents through a window cut in the cortex. This is followed by swabbing out the cavity with an antiseptic solution, and closure without drainage. The cyst cavity then fills with blood which is later organized and finally replaced by normal bone and marrow.

DISCUSSION

The presence of extensive calcification in the cyst wall forming an almost continuous calcareous shell about the cavity, constitutes a very unusual finding in these lesions. Similar observations have not been made

in any other reported case of recent or long duration. In view of the small number of recorded cases of many years' standing, it is impossible to state whether or not much calcareous deposition is characteristic of very old cysts. This was not found in Delchef's case in which symptoms were present for fifty-one years.

The presence of cholesterol crystals in the cyst fluid is also very unusual. This has been observed in but one previously reported case which, however, was of but four years' duration (Fujii[4]). Cholesterol crystals are frequently found in cysts of the mandible developing at the root of a tooth. However, these differ from cysts of the long bones in that they have an epithelial lining.

From what limited studies have been made, there seems to be no general rule concerning the ultimate fate of solitary bone cysts when they go untreated. Repeated pathological fracture may not cause their healing as shown by Elmslie's first case cited above. Rapidity of development also varies widely. In four years Fujii's patient developed an enormous cyst of the fibula, over which the cortex had been so thinned as to give parchment crepitation on palpation. In Delchef's case of much longer duration the cyst was smaller but there was similar crepitation.

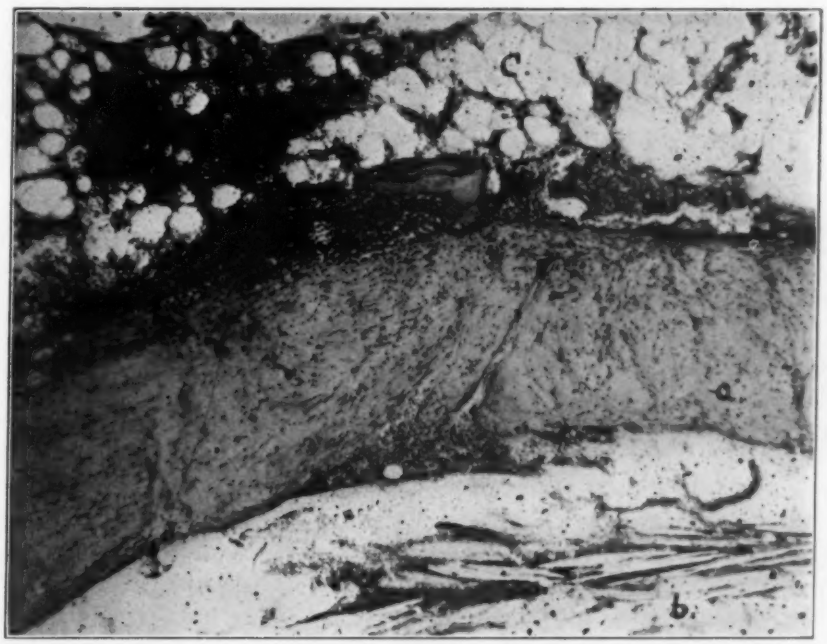

FIG. 5

×70. Section through bone cyst lining showing: *a*. Wide fibrous membrane diffusely infiltrated by leucocytes — no calcareous deposits in this region; *b*. Precipitated granular material of cyst cavity in which are cholesterol crystal clefts; *c*. Fatty and cellular marrow surrounding cyst lining. No evidence of osteitis fibrosa.

Spontaneous healing of these lesions may occur. Wollenberg[5] reports the case of a solitary cyst in the femur of a six-year-old girl, in which the surrounding cortex was still quite thick, and pathological fracture not imminent. On the advice of Hoffa it was treated expectantly and roentgenograms taken a year later showed complete disappearance of the lesion. Bloodgood[6] reports the case of a female, aged forty, exhibiting swelling in the lower part of the leg of twenty-four years' duration, with no symptoms for years. Roentgenogram showed a fusiform expansion of the lower half of the fibula with no definite cyst cavity. At operation normal cancellous bone was found. In the same paper the author refers to another case of cystic swelling of the upper end of the ulna in a girl aged six. The patient was observed over a period of five years and filling of the cyst cavity with bony trabeculae noted; the expansion remained.

The presence also in the case studied above of arthritis deformans involving several joints is very interesting in view of recent bacteriological studies by Cecil, Nicholls, and Stainsby[7] on these lesions, and by Phemister and Gordon[8] and Phemister and Brunschwig[9] on material from bone cysts. Cecil *et al* recovered streptococcus viridans from involved joints in two of six cases of arthritis deformans. The writer[10] also cultured streptococcus viridans from curettings from a hip joint involved in arthritis deformans. Phemister and his coworkers have recovered streptococcus viridans in four cases of solitary bone cyst.

The negative bacteriologic findings in the case reported above militate little against the infectious theory for the etiology of these lesions. For the bone cyst was of very long standing and may have sterilized itself just as very old abscesses, obviously pyogenic in origin, frequently yield no living bacteria. As regards negative cultures from synovial lining of the elbow joint, it may be pointed out that the amount of synovia removed was very small. Experience in culture of streptococcus viridans from lesions has shown that positive yields are obtained as a rule only in those cases where much material was cultured.

Furthermore, the histological appearance of the lining and contents of recent bone cysts is similar in many respects to the appearance of the lining and contents of the smaller cavities found in the ends of bones involved in joints affected by arthritis deformans.

There are several theories for the etiology of solitary bone cyst. A review and discussion of these is beyond the scope of this paper. Since, however, the symptoms in the patient studied in detail above date from trauma, a word may be said concerning the traumatic theory for the origin of these lesions, which has many adherents. Among these, Beneke[11] believed that there may be traumatic hemorrhagic exudation into the marrow, which is not absorbed in the usual manner but results in cyst formation, much in the same manner as apoplectic cysts are formed in the brain. Were trauma the sole factor, experimental production of bone cysts should be quite simple. Lexer[12] and Lotsch[13], however, failed to do this, the latter performing fifty-six experiments with negative results. The purely traumatic theory of bone cysts is rather far fetched.

SUMMARY

1. A case of solitary bone cyst of the humerus of thirty-eight years' standing is reported.

2. It had a fibrous lining which was extensively calcified in almost its entire extent and which cast a shadow in the x-ray.

3. The fluid within the cyst was loaded with cholesterol crystals. In the bone surrounding the cyst lining there was no fibrosis of the marrow; only fatty marrow was present.

4. In the same patient several joints exhibited arthritis deformans, raising the question of a possible bacteriological relationship between the two conditions.

Cultures of cyst lining and contents and of synovia of the left elbow joint in the above reported case were negative. The age of the cyst and the small amount of synovia cultured may possibly account for this.

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BACTERIOLOGY OF APPARENTLY NORMAL BONES*

Further Corroborative Evidence of the Inflammatory Nature of Some Cases of Solitary Bone Cyst

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Since von Recklinghausen[1] first described osteitis fibrosa cystica in 1891, the subject of etiology has received the attention and consideration of many writers on this subject. It is not the purpose of this paper to discuss this vexed matter and no attempt will be made to review fully the extensive literature. For comprehensive data relating to the divergent views as to its etiology, the reader is referred to the writings of these authors and particularly to those of Virchow[2], Rindfleisch[3], Hirschberg[4], M. B. Schmidt[5], Beck[6], Boit[7], Pommer[8], Konjetzny[9], Pfeiffer[10], Bloodgood[11], Lubarsch[12], Silver[13] and Percy[14]. In this connection, however, it may be proper to point out briefly the prevalent recorded assumptions concerning the etiology of this bone disease. The earliest observers, led by Virchow[2], thought that this solitary cystic lesion of bones is the result of degeneration and softening of pre-existing tumors; hemorrhage induced by traumatism is assumed by some; others hold the view that it is a localized malacia; and still others, and probably the majority, attribute the presence of this cyst to an infectious process. From an analysis of the present status of our knowledge on this diseased condition of bones, it appears, as explained by Boit[7], Silver[13], and others, that this solitary bone cyst is probably due to several causes. It goes without saying that as yet there is no established fact on this subject and that the multifarious information thus far accumulated concerning it is nothing more than mere conjecture.

In recent years, it is apparent that the hypothesis that the disease is inflammatory in nature is being given more serious thought, and attempts to produce it experimentally are repeatedly and forcibly brought to our attention. The fact that organisms have been cultured on several occasions from the contents and lining of the cyst (Lubarsch[12], Rapke[15], Murphy[16], and Phemister and Gordon[17]) and the microscopic appearance of chronic inflammation in the cyst wall (Bloodgood[18], Mallory[19], Tietze[20] and Bischoff[21]) lend support to this theory. With a view to further substantiating this claim and attempting to bring additional evidence to its favor, Phemister and Gordon[17] have recently made commendable, although fruitless effort, to reproduce the disease experimentally, utilizing cultures of the organisms both with and without innocuous materials as emboli thrown directly into the bone and blood stream. Except in a case where

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the writer was successful in demonstrating osteomyelitis of the lower end of the tibia, and cyst cavity of the upper end about the region of the tibial tubercle, in a dog, following the injection of a suspension of the organism (streptococcus viridans), as will be reported later, it is justifiable to state that animal experimentation to reproduce the disease has, as a whole, been a failure. For this reason, it is evident that the presence and isolation of the organism, which in the great majority of the positive cases has been the streptococcus, can not be taken as more than a suggestive possibility as to its rôle as a causative agent of the disease. This bacteriological and experimental experience naturally raises the question as to whether or not, like some of the supposedly normal tissues of apparently healthy animals, the human bones as well as those of the experimental animals, normally harbor bacteria. The literature reveals no reports of work on this matter. It is with this problem that the present communication is chiefly concerned.

It would be to no purpose to review the numerous investigations that have been published concerning the bacteriological findings of normal tissues from apparently healthy animals. In this connection, however, the results of the observations of some of the workers as exhaustively reviewed by Reith[22] may be advantageously summarized. Boni[23], in 1901, examined the lungs of twenty hogs for aerobia and found fourteen (70 per cent.) were positive; and among ten lungs of guinea-pigs, two (20 per cent.) were positive. Saski[24], in 1908, could isolate thirty-nine strains of bacteria from eight organs of apparently healthy guinea-pigs and mice. In 1908, Conradi[25] found that seventy samples (40 per cent.) of muscle, liver, kidney, lung, lymph node and spleen of one hundred and fifty slaughtered cattle and hogs were not sterile. Amako[26], in 1910, examined eighty-eight samples from muscle, spleen, kidney, and liver of cattle and found aerobia present in forty-eight (55 per cent.). Bugge and Kiessig[27], repeating this work in 1911, examined two hundred and forty-one muscle samples from apparently normal and freshly slaughtered cattle and found aerobia in thirty-six samples (15 per cent.). Again, in 1919, they repeated these tests, using two hundred and eighty-three samples, and obtained positive growths in twenty-three per cent. In 1926, Reith[22] tested samples taken from muscles of hams at various stages during slaughter and also from muscles and blood of apparently normal live hogs, rabbits, and guinea-pigs. He found that cultures of muscle of slaughtered hogs showed the presence of bacteria in seventy-seven per cent. of two hundred and sixteen samples; and eighty-three per cent. of one hundred and eight muscle samples, and sixty-seven per cent. of eighteen blood samples from healthy live hogs, rabbits, and guinea-pigs.

It is therefore obvious that bacteria may be found in many of the organs of apparently healthy animals. This finding seems to warrant consideration of the osseous tissue along the same line, particularly directing careful attention toward streptococcus and staphylococcus, because of their frequent association with many obscure bone diseases, as exempli-

fied by solitary bone cysts. Of the various organisms which have been described in connection with this bacteriological study, the staphylococcus proved to be the most frequent. In a few instances other organisms, as bipolar rods, gram-positive and gram-negative rods have been isolated. At no occasion, however, has the streptococcus been obtained.

In this paper, the results of the bacteriological tests, made on a series of twenty-four separate samples of the cortex and marrow of supposedly normal bones of nineteen patients selected at random and subjected to operations due to various surgical ailments, are presented. Another series of twenty-four separate samples of the cortex and marrow from ten live and apparently healthy dogs have also been studied.

METHOD OF STUDY

An attempt has been made in the experimental work to expose the bones in the human and subsequently remove pieces of the cortex and

TABLE I

RESULTS OF BACTERIOLOGICAL EXAMINATIONS OF APPARENTLY NORMAL HUMAN BONES

Patient	*Bone*	*Cortex*	*Marrow*	*Remark*
1	Femur	No growth	No growth	The samples were negative for growth for a period of three weeks, and were therefore considered sterile.
2	Metacarpal	No growth	No growth	
3	Clavicle	No growth	No growth	
4	Humerus	No growth	No growth	
5	Humerus	No growth	No growth	
6	Femur	No growth	No growth	
7	Tibia	No growth	No growth	
8	Tibia	No growth	No growth	
9	Tibia	No growth	No growth	
10	Tibia	No growth	No growth	
11	Femur	No growth	No growth	
12	Rib	No growth	No growth	
	Rib	No growth	No growth	
	Rib	No growth	No growth	
	Rib	No growth	No growth	
	Rib	No growth	No growth	
	Rib	No growth	No growth	
13	Radius	No growth	No growth	
14	Radius	No growth	No growth	
15	Tibia	No growth	No growth	
16	Radius	No growth	No growth	
17	Humerus	No growth	No growth	
18	Tibia	No growth	No growth	
19	Tibia	No growth	No growth	
Total	24	0	0	

marrow aseptically as in routine operations. In the dogs, the samples were removed with sterile instruments in a blood-free field while they were under light ether anaesthesia. The operations were performed with special precaution against contamination. The fields of operation were carefully and thoroughly washed with soap and water, shaved, and subsequently swabbed with concentrated carbolic acid. The materials were obtained separately from the cortex and marrow of the humerus, radius, femur, and tibia and dropped into tubes of ascites (10 per cent.), dextrose (0.2 per cent.), broth. They were incubated at thirty-seven degrees centigrade and were watched for growth for three weeks. During this period, if any clouding of the medium appeared, the tube was plated out on blood agar and incubated. Identification of the organisms was made on the basis of morphology. Blood cultures were made just before the time of culturing. Ten cubic centimeters of blood were withdrawn from the jugular vein and inoculated into fifty cubic centimeters of dextrose broth. No attempts were made to make anaerobic cultures.

The results are summarized in the accompanying tables.

TABLE II

RESULTS OF BACTERIOLOGICAL EXAMINATIONS OF THE BLOOD AND BONES OF APPARENTLY HEALTHY DOGS

Dog	*Bone*	*Cortex*	*Marrow*	*Blood Culture*
1	Humerus, left	No growth	B. subtilis	No growth
	Radius, left	No growth	No growth	
	Femur, left	No growth	Staph. aureus	
	Tibia, left	No growth	No growth	
2	Humerus, left	No growth	No growth	No growth
	Radius, left	No growth	No growth	
	Femur, left	No growth	No growth	
	Tibia, left	No growth	No growth	
3	Tibia, right	No growth	No growth	No growth
	Tibia, left	No growth	Staph. aureus	
4	Tibia, right	No growth	No growth	No growth
	Tibia, left	No growth	No growth	
5	Tibia, right	No growth	No growth	No growth
	Tibia, left	No growth	No growth	
6	Tibia, right	No growth	No growth	No growth
	Tibia, left	No growth	No growth	
7	Tibia, right	No growth	No growth	No growth
	Tibia, left	No growth	No growth	
8	Tibia, right	No growth	No growth	No growth
	Tibia, left	No growth	No growth	
9	Tibia, right	No growth	No growth	No growth
	Tibia, left	No growth	No growth	
10	Tibia, right	No growth	No growth	No growth
	Tibia, left	No growth	No growth	
Total	24	0	12.5%	0

COMMENT

The results reported in Table I appear to indicate that under ordinary conditions human bones are sterile. It will be noted that in no case has positive culture been obtained from the bones of apparently normal individuals. All of the tubes and plates showed no growth for a period of three weeks. In the dogs, however, two marrow samples (8.4 per cent.) from the left femur and left tibia of Dogs 1 and 3 respectively, showed pure culture of staphylococcus aureus (Table II). The material from the marrow of the left humerus of Dog 1 revealed pure culture of subtilis bacillus (4.2 per cent.) after twenty-four hours. Blood culture was negative in every instance.

Although this work was done upon only a small series of bone samples, nevertheless the results are so uniform and striking that they justify the drawing of the following deductions:

CONCLUSIONS

1. Aerobic cultures from twenty-four separate samples of the cortex and marrow of apparently normal human bones are sterile.
2. Aerobic cultures from twenty-four separate samples of the cortex and marrow of bones from ten live and apparently healthy dogs show staphylococcus aureus in eight and four-tenths per cent. and subtilis bacillus in four and two-tenths per cent.
3. Blood culture from these dogs has always shown no growth.
4. Streptococcus has not been cultured from ninety-six separate samples of the cortex and marrow of human and dog bones.
5. The streptococcus and staphylococcus recovered and cultured from the contents and lining f some cases of solitary bone cysts are not ordinarily found in normal human bones. They are likely to be in association with and perhaps the cause of the disease.
6. The bone marrow of apparently healthy dogs may infrequently harbor staphylococcus aureus and subtilis bacillus.

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LATE TREATMENT OF CORD-COMPRESSION FRACTURE OF THE SPINE

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What ultimately becomes of the unfortunate individual who has a broken back? There is a paucity of literature on the subject of the end-results of these fractures—the cases in which there is definite permanent cord destruction as distinguished from the more fortunate patients for whom some early measures for relief can be done.

In the experience of most of us, these patients are doomed to lie abed, or at best, to navigate about in wheel chairs with no better future to look forward to. In an attempt to improve the outlook for cases of this type, constructive effort was made in the two cases reported here to enlarge their horizon of physical endeavor. By use of various orthopaedic appliances, both of these patients are now able to walk with the aid of crutches and without assistance. The concurrent improvement in their physical condition and their morale has been remarkable. One of them, doomed, apparently, to a lifetime in bed, has taken a course in bookkeeping and accounting and has gone back to his firm, in which he is a partner, fully capable of carrying on the financial end of the business of the firm.

REPORT OF CASES

CASE 1. H.H.D., age thirty-three, Armenian-American male, admitted to U. S. Naval Hospital, Chelsea, Massachusetts, August 23, 1927.

Chief Complaint—Inability to use legs.

History of Present Illness—On October 27, 1926, while inspecting a building and in a stooped position he passed under an elevator which accidentally descended upon him. He suffered fracture, confirmed by x-ray examination, of the first lumbar vertebra with moderate crushing of body and backward displacement of one-half to one-quarter of an inch. There was also displacement of the twelfth dorsal vertebra one-half inch laterally. He was hospitalized in a civilian hospital until February 17, 1927, showing the usual signs of recent cord fracture, including urinary and fetal retention and later incontinence and a decubitus ulcer over the sacrum. On admission to the U. S. Naval Hospital, Chelsea, Massachusetts, August 23, 1927, he showed the following positive points on physical examination.

Back—Slight left scoliosis in lower thoracic and upper lumbar region with markedly increased upper lumbar lordosis anteriorly. Large deep granulating decubitus ulcer over sacrum.

Neurological examination (positive points)

Knee and ankle jerks absent.

Babinski and Oppenheim negative.

The only voluntary movements of the legs were:

1. Ability to raise the right heel about one-quarter of an inch from the bed in the extended position.

2. Slight ability to rotate the left leg at the hip in the extended position.

FIG. 1

Case 1, showing standing position with crutches, and the use of the short foot-drop brace. Note lordosis.

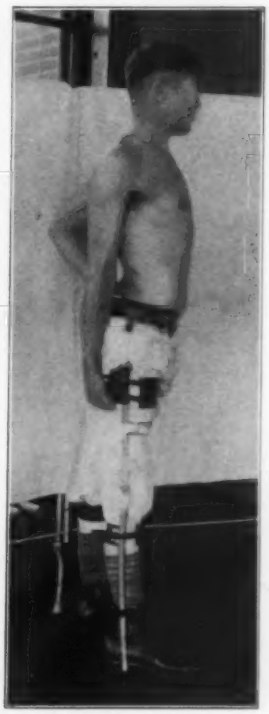

FIG. 2

Case 1. Patient standing without assistance by bracing himself with his hand on his appliance. Long hip appliance shown.

Complete anaesthesia of entire left leg.

Small areas of hyperaesthesia of the right leg, the rest being definitely anaesthetic.

Skin of both legs dry and flaky. Oedema of both feet. Definitely decreased cutaneous sensibility over right lower back. Left lower back anaesthetic. Marked atrophy of muscles of legs and buttocks.

Progress—From the time of admission until April 1928, patient was about in a wheel chair but made no attempt to stand. Feet were splinted to prevent drop. Manipulation and physiotherapy were used. On April 25, 1928, patient made first attempt to stand with support. He had no control over left leg. Attempts to stand were continued, leg being supported. Two and one-half months later patient was able to walk a little with supports. Orthopaedic braces with foot-drop stops were used on both legs. With these the patient was able to walk on crutches without attendants. August 27, 1928, patient was put in "go-cart" for muscle education. From this time on the patient has gradually become more efficient in walking without apparatus save orthopaedic braces and crutches. At present he gets about actively, is able to go up and down stairs and can stand without crutches or other assistance by holding on. June 22, 1929, patient was discharged to home. Examination shows complete loss of sensation in both legs and buttocks, motor power entirely absent below hip muscles, lower leg powerless, complete foot-drop. Small decubitus ulcer over sacrum. Has control of bladder and rectum. Marked anterior lordosis of lumbar spine.

CASE 2. C.M.O'C., male, age thirty-four years, admitted January 2, 1925, complaining of fracture of spine with an accompanying paralysis of lower abdomen and legs from

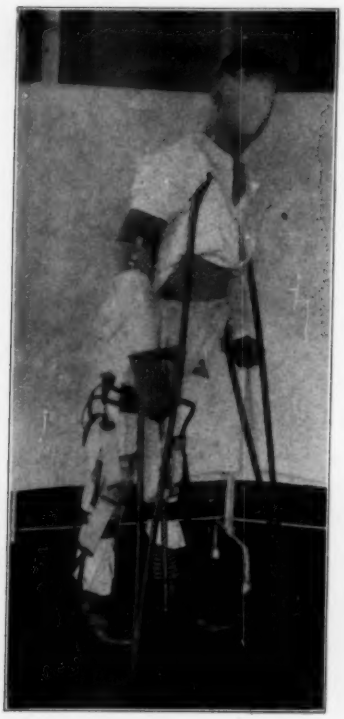

FIG. 3

Case 2, showing artificial arm and cage on crutch for hand; also details of orthopaedic braces and elastic spring check for knee joint.

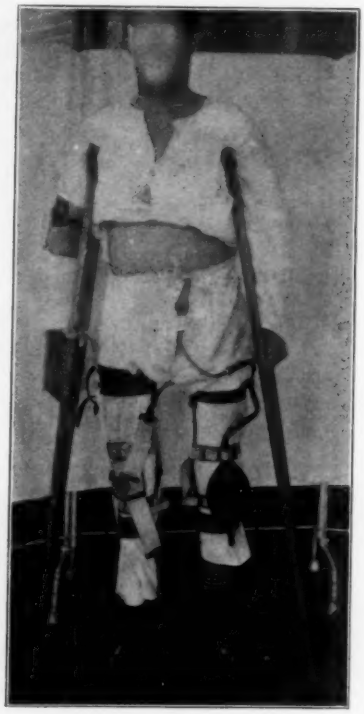

FIG. 4

Case 2. Front view, showing details of braces, use of bladder drain, and the artificial arm.

about the second lumbar vertebra down, with an amputation of the right forearm at the junction of the lower and middle thirds.

Present Illness—Dates from September 4, 1922, at which time he was struck by a locomotive while crossing a freight yard, causing a fracture of the second lumbar vertebra, traumatic amputation of right hand, and several scalp wounds. Amputation of right forearm was performed at that time and one week later an Albee bone graft was inserted at the site of fracture of spine, and also a suprapubic cystotomy was performed. He was kept in bed prior to admission to this hospital.

Physical Examination on admission shows customary signs of lumbar spine fracture; very large decubitus scar over sacrum. Patient was placed on Bradford frame lying on his stomach, which position he maintained, with the exception of four or five hours a day in a wheel chair until about June 1928. About five months after admission, it was noticed that patient had very slight motion of the muscles of the leg and in May 1926 there was some evidence of muscle regeneration of the thighs especially of the adductor group and beginning control of anal sphincter. During this period various forms of physiotherapy and hydrotherapy were used, and beginning in June 1928, an effort was made to have the patient take exercise by walking. The loss of the right forearm, on which the patient had an artificial hand and arm, interfered with the ordinary use of crutches. As Figure 3 shows, this handicap was overcome by the use of an ingenious wire cage for the artificial hand. In August 1928, orthopaedic appliances with foot-drop stop and lock-knee joint were applied. Since that time patient has made considerable progress in his walking and has been taught to clear a four-inch obstruction on the floor.

His leg braces have been altered to allow the patient to flex his knees when walking and to extend them automatically upon raising the foot from the floor. There is now beginning evidence of a restoration of bladder sphincter control. There has been considerable regeneration of the abductor and adductor groups of both thighs. Reflexes are still lacking. This patient spent more than five years in bed, mostly lying prone except for short spells in a wheel chair. He now changes his position in bed at will, lying on either side, back, or front. He spends upward of four hours daily on his feet, walking without personal assistance and goes at will about the hospital grounds. He has not been able to go up or down stairs.

THE APPLIANCES

In Case 1, the patient's ability to lock the knee-joint permitted us to use simple foot-drop braces below the knees (Fig. 1). Later, owing to a marked spastic external rotation of the right leg and foot that occurred when he brought this leg forward, a brace was designed, as shown in Figure 2. This included the foot-drop feature, a knee joint, a hip joint, and a metal U-shaped clasp for right pelvic brim, which kept the leg from rotating.

The "go-cart", designed by one of us (W.A.A.), originally for ambulant treatment of fractures of the leg, is well illustrated in Figure 5 and requires no description.

FIG. 5

The "go-cart". The front bar of the upper frame is hinged at one end so that patient may get in and out. When in place it locks securely over a metal pin.

In Case 2, the patient had no control at all over any muscle below the hips. The usual foot-drop brace was extended upward on to the thigh with a lock-joint at the knee. Much of the time he walks stiff-kneed, but of late a knee-cap pad for the right leg has been added which is fastened to the frame of the brace by elastic webbing. This permits a bending of the knee joint sufficient to allow him to bend it at the end of his step, the knee locking automatically, however, when the leg is brought forward (See Figures 3 and 4).

SUMMARY

Two cases of permanent uncurable fractures of the spine are reported for which orthopaedic braces have been made that permit the patient to get about with the aid of crutches, after one and one-half and five years in bed, respectively.

The appliances used are not beyond the capacity of any brace-maker.

The improvement in the physical condition, morale, and mental outlook of the patients has been remarkable. One of the two patients has returned to economic independence.

UNUSUAL APPEARANCE OF THE ACCESSORY SCAPHOID AND THE STYLOID EPIPHYSIS OF THE FIFTH METATARSAL*

Report of a Case

BY M. S. BURMAN, M.D., AND PAUL W. LAPIDUS, M.D., NEW YORK, N. Y.

We recently observed an unusual change in the accessory scaphoid and in the styloid or proximal epiphysis of the fifth metatarsal of the foot, which we interpreted as an epiphysitis. This was the only case of its type seen in a large clinical material in the Foot Room of the Dispensary of the Hospital for Joint Diseases. We therefore feel it merits report.

Case No. 57879. H. B., a girl, aged eight and a half, was first seen in the dispensary on October 13, 1928, because of a tired feeling in her feet and legs, and because of the presence of a bony lump on the inside of each foot. The duration of symptoms was six months. There had never been any actual pain in her feet. Examination showed feet moderately pronated, with some limitation of dorsiflexion. The feet were long and narrow, and on the inner side of each foot, in the region of the scaphoid, there was a marked bony prominence, which suggested very definitely the presence of the accessory scaphoid. No reference is made in the history taken then regarding tenderness over this point, or over the outer aspect of the foot at the base of the fifth metatarsal. She denied any pain or tenderness at these spots on later questioning. An x-ray of both feet was taken the same day. She obtained relief from exercises and proper shoe corrections. She was seen again, very much improved, on July 9, 1929, at which time another series of plates was taken. There was no tenderness or swelling over the prominent scaphoid or over the outer border of the foot.

There was noted in the first series of x-rays the bilateral presence of the accessory scaphoid and of the styloid epiphysis of the fifth metatarsal. These were the site of an interesting change. The bone outlines were clear, but the bones were larger than usual. Both the accessory scaphoids and the styloid epiphyses had a patchy moth-eaten appearance, interpreted as an epiphysitis. The second set of x-rays, taken about nine months later, showed the complete restitution of the accessory scaphoids, the styloid epiphyses still showing some enlargement and patchy density.

The accessory scaphoid exists as a preformed cartilage at the second month of foetal life, a fact noted by Bardeleben[5] and Dwight[6]. It is not manifested radiographically until the age of nine, more usually eleven, according to Sever[7]. From our own observations, we have noticed that the accessory scaphoid is usually well outlined and of homogeneous density at all ages. It often fuses with the scaphoid but may have an epiphyseal center of its own. There may be multiple centers of ossification. Jaboulay[8] believed this bone to be an epiphysis of the scaphoid. This is not so.

The styloid epiphysis of the fifth metatarsal has been the subject of some controversy as to whether or not it is the vesalian bone. Froelich and his pupil, Loyer, believe in the identity of the two. Davis[9] maintains

*From the Dispensary of the Hospital for Joint Diseases, Service of Dr. Leo Mayer.

FIG. 1-B

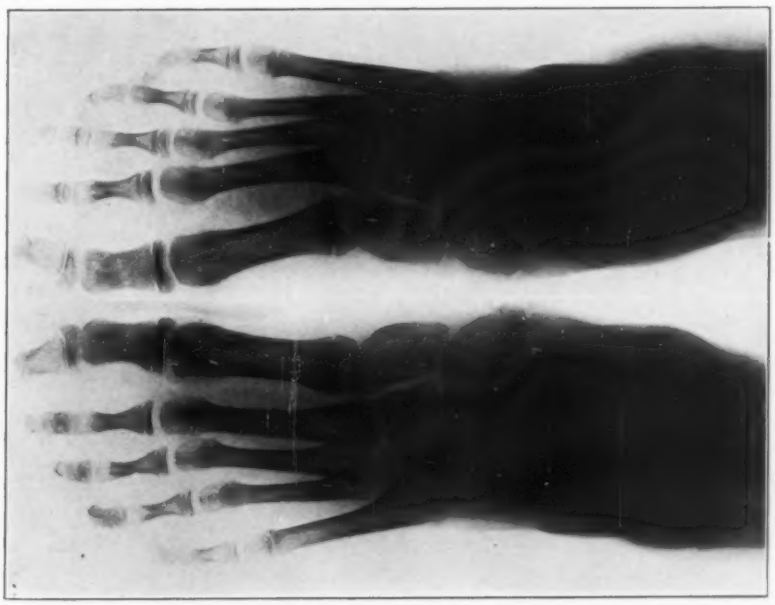

FIG. 1-A

Anteroposterior and lateral views taken on October 13, 1928.

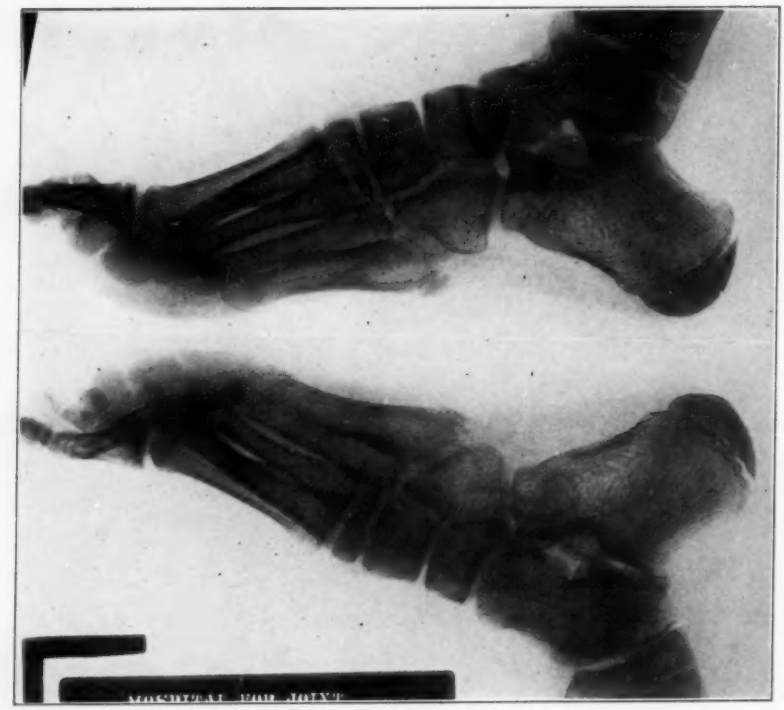

FIG. 2-B

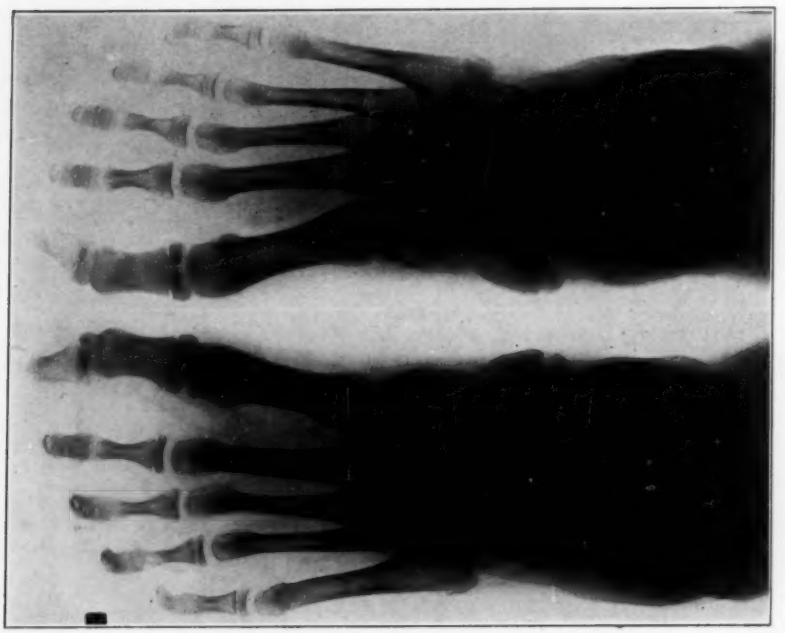

FIG. 2-A

Note the complete restoration of the accessory scaphoids. X-rays taken about nine months later.

that no vesalian bone has ever been seen in an adult and thinks it the styloid epiphysis. Laquerrière and Drevon[10] and Dwight deny the oneness of the two. Geist[11] was inclined to believe that the two are different. Iselin and Kirschner[12] have seen non-joined posterior epiphyses of the fifth metatarsal. Lilienfeld[13] is the complete skeptic and disbelieves the existence of both, calling both fracture. Spronck[14] noted the presence of the posterior epiphysis of the fifth metatarsal in a new-born child with polydactylia. The radiographic frequency of the os vesalianum is one in ten thousand, while the styloid epiphysis is seen in twenty-eight per cent. of subjects between ten and seventeen, according to Rogers[15]. In a recent review of several hundred x-rays of the feet, with especial regard to the supernumerary bones, we observed a fair number of styloid epiphyses, none of which presented the appearance reported above.

Despite the absence of tenderness, we feel this case to be an epiphysitis; the age of the patient, the similarity of the x-ray to those other epiphysites —as Osgood-Schlatter's disease, Perthes' disease etc.—and the complete restitution of the accessory scaphoid, all favoring that diagnosis. However, we can not be definitely certain. The existence of epiphysitis of the supernumerary bones of the foot though postulated by several authors, has been actually reported but once. Froelich[1], in a discussion on the differential diagnosis of the accessory scaphoid, said that the posterior epiphysis of the scaphoid may be the site of an epiphysitis, the more so when it has a separate bony nucleus. Loyer[2] repeats this statement. Japiot[3], from a study of several radiographs of the foot, saw no reason why a tarsalgia of adolescence, due to an inflammation of the accessory scaphoid and the os peroneum, might not occur. Iselin[4] was the only one to report a case of epiphysitis of the styloid epiphysis of the fifth metatarsal, the patient a girl of thirteen. Kidner[16] says that a condition of the accessory scaphoid resembling Köhler's disease has been described. We have not been able to find the exact reference.

As in all epiphysites, one may speculate on the etiology of this condition, whether traumatic, infectious, circulatory, etc. We know of no study on the vascular supply of the supernumerary bones of the foot. Presumably, it is derived from the vessels to the adjacent bones. There is nothing in this girl's history to account for her condition. This change most probably was a "silent" epiphysitis, in which the prognosis was good. It is possible that the disease would be found to be more common, if x-rays were taken at the opportune time.

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OSTEOMYELITIS OF ILIUM (PROBABLY TUBERCULOUS)

Case Report

BY CLARENCE A. RYAN, RESIDENT, AND ROBERT V. FUNSTON, CONSULTANT

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Tuberculous osteomyelitis of the ilium is seldom seen. In a review of the literature we have been able to find reference to only one case, that reported by Nélaton[1] in 1892. Since that time, however, there must have been other patients seen with such a location of the disease though not reported.

H. S., Case No. 1730, was admitted to the Wm. H. Maybury Sanatorium, March 27, 1925, at the age of five years. Since December 1923 he had not been well. He had lost ten pounds in weight, tired easily, had coughed occasionally, sweated profusely, and complained of sharp pains in his left leg.

His past history was not interesting except that the child had had whooping cough, measles, and chicken-pox.

His family history was of more interest. His father was a patient in this Sanatorium with a diagnosis of pulmonary tuberculosis at the time the child was admitted. Two other children, one six and one three years of age, were healthy.

FIG. 1

March 25, 1925. X-ray appearance of lesion at the time of admission to the sanatorium. The notch in the ilium just above the acetabulum was about three-eighths of an inch deep and a half-inch in circumference at this time.

In January 1925 he was first seen in the clinic. At this time he limped on walking, and walked with the left leg rotated externally. He was having night sweats and considerable pain in his hip. There was a swelling over the left acetabulum, extending from the mid-line of the anterior surface of the leg around to the lateral side of the thigh. The swelling was intensely tender, but not fluctuating. Motion of the left leg was limited in all directions, muscle spasm was marked, but passive motion did not produce pain. Owing to the crowded conditions at the children's division at that time, the child could not be admitted until March 27, 1925.

On admission the temperature ranged from 101 to 102 degrees, and the child did not sleep, and cried from the pain around his left hip. Twelve days later, April 8, 1925, a definite abscess formed just above and posteriorly to the great trochanter of the femur. This was aspirated on April 19, and pus for laboratory tests was removed. Otherwise it was not interfered with, and broke open of its own accord on April 22, 1925. The laboratory report showed a staphylococcus growth only. After the abscess broke open, the child's temperature fell from 101.6 to 99.6 degrees. From this time until July 28, 1925, discharge continued from the abscess. Heliotherapy was started July 1, 1925, and the drainage decreased in amount and finally ceased. On October 1, 1925, the child was allowed out of bed fifteen minutes daily. Eleven days later another abscess formed in the same location as the former one, and discharge, which was blood-tinged, continued until October 30, 1925.

The case was taken over by this Service on December 1, 1925. The child was confined to bed; there was no discharge from the sinuses; muscle spasm was still present to a very slight degree; there was no pain on passive motion; and motion was not limited to any

FIG. 2

March 13, 1929. The former area of rarefaction just above the acetabulum has almost completely disappeared,—only a very slight indentation in the surface of the bone can be made out.

FIG. 3

April 5, 1929. This plate was taken when the patient had been home for ten months and had been walking without crutches for one month. There is apparently complete healing of the lesion.

demonstrable extent in any direction. The x-ray, however, showed the bone destroyed just above the acetabulum of the left ilium; there was no bone production; and the radiologist considered the lesion to be undoubtedly tuberculous in origin.

Because there was still some muscle spasm present and because new abscesses had developed on each attempt at walking, it was decided to immobilize the leg and hip in plaster, and a cast extending from the costal border to the toes of the left foot was applied on January 15, 1926. A window was cut over the sinus scars and carbon-arc radiation to the whole exposed body started. A von Pirquet test was made February 1, 1926, which was positive. Tonsils and adenoids were much diseased and their removal was done October 11, 1926. Plaster-cast treatment was continued until May 16, 1927, at which time the cast was finally removed and Bradford-frame treatment substituted. There were no signs or symptoms of activity in the lesion at this time and the x-ray showed the diseased area to be smaller and filling in, but still present and not healed. In November 1927 all physical signs of disease were absent and it was thought permissible to permit a trial on crutches. The child's temperature, however, rose to 100 degrees and reapplication of a cast was advised. On April 12, 1928, the lesion again seemed quiescent and a walking caliper was fitted. The child was allowed up and around the ward, and in June was permitted to walk to the dining room for all meals. In the latter part of June his exercise was increased and he was allowed to go to school and play to a limited extent outside. There were no further exacerbations either of temperature, pulse, or symptoms, and the child was discharged July 15, 1928. The x-ray taken at this time showed a lesion which had almost disappeared and which, in this one series of plates, could not be definitely diagnosed. Frequent examinations of the child were made, the last on March 13, 1929, at which time there were no physical signs or symptoms of disease and the x-ray plates showed an entirely healed area where the lesion had previously existed.

SUMMARY

Onset: December 1923.
Treatment started: March 1925.
Abscess formation: April 1925.
Casts: January 1926 to May 1927, December 1927 to April 1928.
Brace: April 1928.
Heliotherapy: July 1925 to July 1928.
Discharged: July 1928.
Last examination: March 1929.

This case is reported as probably tuberculous, though we do not have any laboratory proof to offer in substantiation of the diagnosis. The history, physical findings, x-ray, and course of the disease were all typical of a tuberculous process so that we feel justified in making that diagnosis.

The case is reported because of the rarity with which tuberculosis of the ilium is encountered.

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RECURRENT FRACTURE OF THE HUMERUS DUE TO SUDDEN EXTREME MUSCULAR ACTION

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While fractures of the humerus due to sudden extreme muscular action are not rare, yet the recurrence of the fracture of the same humerus a year later under identical circumstances, seems of sufficient interest to report.

A patient with a fracture of the right humerus was first seen on July 1, 1928. He was a young man of twenty-two, extremely well developed muscularly and apparently in excellent health, except for the injured arm.

He stated that he was pitching for his local ball team. He attempted to throw a "drop" when he felt a sudden snap. His arm dropped to his side. There was extreme pain in the arm and he found he was unable to use his arm following the accident.

Examination revealed the usual signs and symptoms of a fracture of the right humerus in the middle third. The x-ray revealed a spiral oblique fracture of the humerus extending from a point just below the insertion of the deltoid muscle upward and inward. The line of fracture apparently extended between the attachment of the lateral head of the triceps muscle and the medial head of the biceps muscle posteriorly, and between the attachment of the brachialis and the coracobrachialis on the one side and the deltoid, pectoralis major, and teres minor on the other, as viewed from the anterior aspect. The distal end of the proximal fragment was drawn laterally by the contracture of the deltoid muscle. Recovery was uneventful and there was complete restoration of function following this injury.

On May 24, 1929, approximately eleven months later, the patient again came under the writer's care for a fracture of the right humerus. He stated that he was pitching a ball game when he attempted to throw a "drop". He heard a crack, his arm fell to his side and he realized that he had again fractured his right humerus.

The first impression was that probably incomplete bony union, or a combination of bony and fibrous union had resulted from the previous fracture, leaving a weakened point which had refractured. However, upon comparing the x-ray pictures and super-

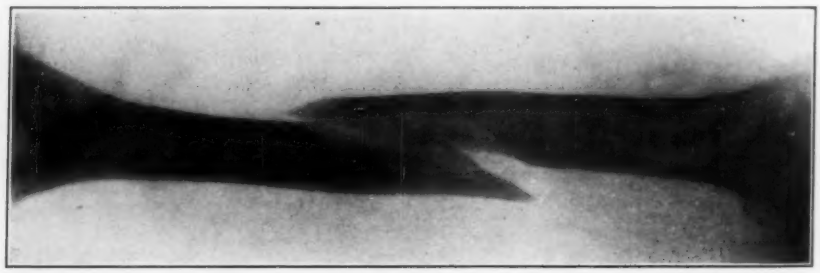

FIG. 1

Fracture occurring July 1928. Oblique, spiral line of fracture. Due to sudden extreme muscular action.

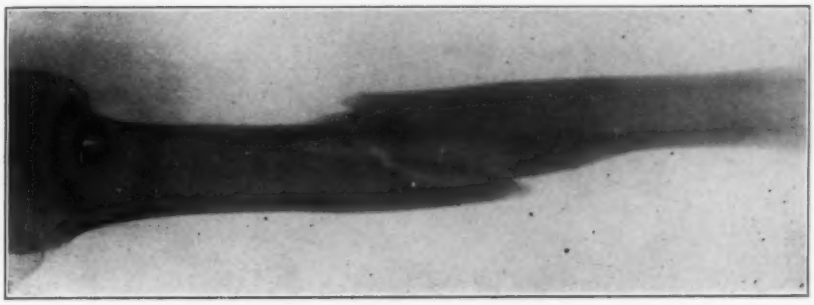

FIG. 2

Fracture of same humerus eleven months later, due to sudden extreme muscular action.

imposing one upon the other, it was found that the two fracture lines were quite different. The former was a long spiral fracture, while the recent one was an oblique fracture scarcely more than half the length, and with its lower point about one-half inch above that of the previous year. Although the second fracture occurred in the same location of the humerus, it did not follow the same course and could not be attributed to an incomplete union of the fragments at the previous fracture.

To all appearances it must be considered a recurrent fracture of an apparently sound humerus, in a well developed muscular young man, due to sudden extreme muscular action.

DISLOCATION OF THE PISIFORM ASSOCIATED WITH FRACTURE OF THE HEAD OF THE RADIUS AND THE STYLOID PROCESS OF THE ULNA*

BY GEORGE WAGONER, M.D., PHILADELPHIA, PA.

Dislocation of the pisiform occurring alone or associated with fractures in and about the wrist joint is rare. Cotton[1] cites one case not verified by x-ray. Speed[2] lists four authors reporting this condition.

The following report describes a case of dislocation of the pisiform associated with fracture of the head of the radius with impaction, and fracture of the styloid process of the ulna, produced by direct trauma to the right hand.

The patient, M. M., is a woman forty-five years of age. While carrying a number of letters in her right hand she slipped on a highly waxed floor and fell, striking the ulnar surface of the right forearm against the floor.

The patient was seen an hour and a half after injury. At this time there was swelling, pain, tenderness, and limitation of motion of the right wrist joint. The ulnar surface of the forearm from elbow to wrist was rapidly becoming discolored. A typical "silver-fork" deformity was not present. At the level of the wrist joint there was a prominence on the dorsal surface and a lateral prominence on the radial side. There was an acute deviation of the hand to the ulnar side. Pain and loss of voluntary motion in the fifth finger was an interesting feature.

An x-ray examination revealed a transverse fracture of the lower end of the radius about one-half inch from its articular surface. A slight amount of impaction was present and one or two comminuted fragments were displaced dorsally. The styloid process of the ulnar was shattered and fragments displaced externally. The pisiform bone was luxated by rotation downward and inward, the center of rotation being through its upper pole. During the course of this rotation the lower pole of the pisiform evidently came in contact with the styloid process of the ulna with sufficient force to cause a complete fracture of this prominence.

Under a general anaesthetic and with the aid of the fluoroscope, the dislocation of the pisiform was reduced and the fragments of the radial fracture were placed in better alignment.

Fixation was maintained by a posterior molded cock-up splint. Passive motion of the wrist, active motion of the fingers, baking and massage of the forearm and wrist were started within the first twenty-four hours after injury and continued daily.

The patient was discharged with an excellent anatomical and functional result five weeks after the original injury.

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*From the Graduate School of Medicine of the University of Pennsylvania.

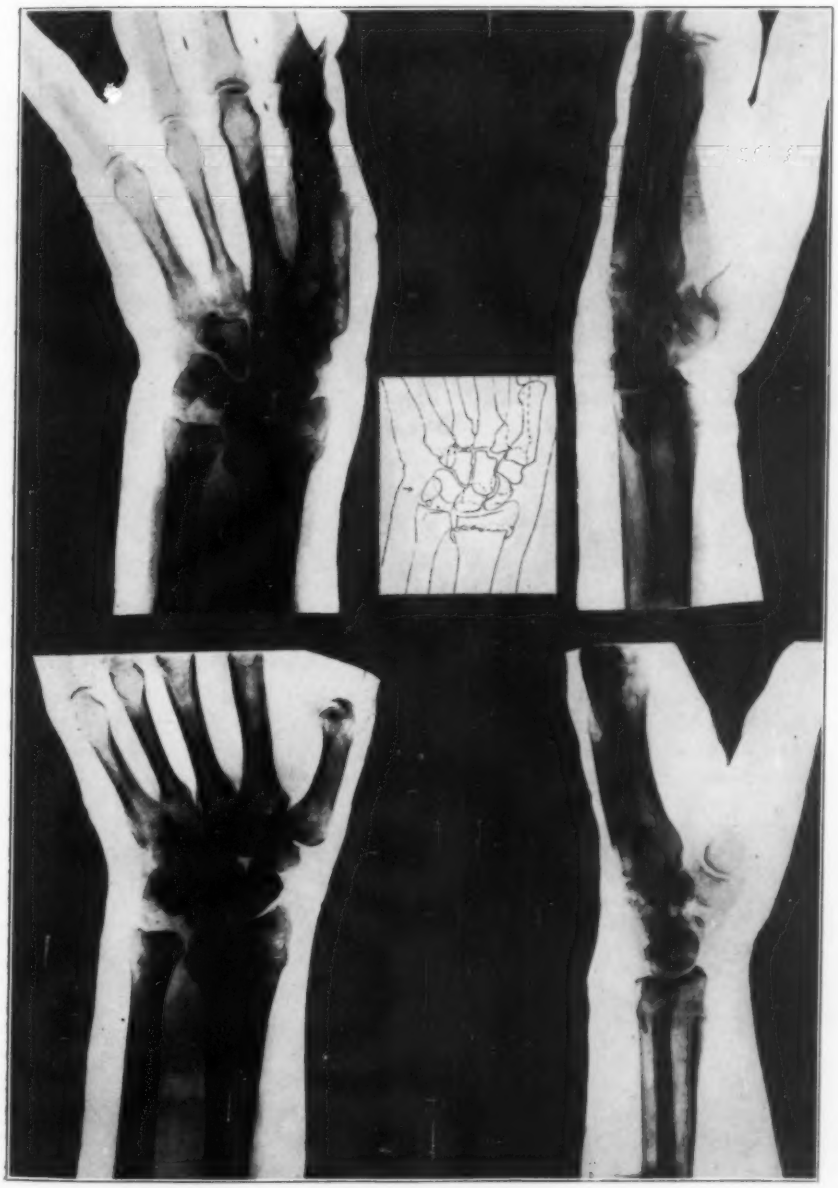

FIG. 1.

Anteroposterior and lateral x-rays, before and immediately following reduction. Note abnormal contour of skin line in upper two x-rays.

CLEFT HAND

Report of a Case

BY SAMUEL W. BOORSTEIN, M.D., F.A.C.S., NEW YORK, N.Y.

Congenital malformation of the upper extremities is of greater importance to the teratologist than to the practical surgeon, as such cases are so often incurable. It is, however, of extreme importance that every case of rare congenital deformity coming under the care of the surgeon should be reported, as it may be helpful in further investigations both of an embryological and an anatomical nature. It will also shed more light on the question of etiology.

Cleft hand (lobster-claw hand) is a very rare deformity. Only a few cases have been reported in the literature. Steindler[1] in his monograph collected six cases and adds two of his own.

One such case came, immediately after birth, under the writer's observation. It is reported here, so that it may be added to the literature. It is hoped that the child may be kept under observation and further progress of the case reported.

HISTORY OF THE CASE

H. C., female, born on July 26, 1929. Family history negative. No other member of the family has a similar or allied deformity. No consanguinity. Both parents are healthy. Mother is twenty-eight years old. This child is the third; the other two are alive and well. The delivery was normal; vertex presentation.

Fig. 1

Right hand. Showing all three fingers.

Fig. 2

Right hand. View from palmar aspect.

Physical Examination: Child is rather small. The right hand shows distinct radial deviation of forearm and tendency to keep elbow flexed, but with little force it can be extended. Forearm is kept supinated. Child has a thumb, index finger, and a rudimentary ring finger. Apparently only three metacarpals are present. The first metacarpal is joined at an angle of seventy degrees to the index finger. Thumb has its phalanges intact. The index finger seems to have some stiffness at proximal interphalangeal joint in that it cannot be flexed fully though it extends fully. Abduction of thumb is somewhat limited; otherwise the child uses the thumb and index finger fairly well. The infant actually uses the fingers in the same style as the lobster uses its claws. The third (ring) finger has all the phalanges present, but they are all small; the terminal phalanx is hardly palpable; the finger is flexed at the interphalangeal joints, and the entire finger lies under the index finger, though it can easily be separated. There is no power of extension in that finger, and only slight power of flexion (Figs. 1, 2, and 3).

FIG. 3

Right hand. Showing the usual position in which child keeps the fingers.

Left hand has a thumb and index finger. Both are thinner than normal. There is power in flexion, extension, and abduction, but not as much as in the right hand. There is also a defect in the forearm bones. The left forearm is shorter than the right (right is three inches long, and left two inches). The entire forearm is displaced upward and outward with a marked convexity to the radial side in the middle of the forearm. One feels that the ulna is absent. There is a wrist joint, but only two metacarpals,—the first and index are present (Figs. 4 and 5).

FIG. 4

Left hand. Usual position in which fingers are kept. *X* indicates the elbow joint.

The lower extremities are also deformed. The right foot has a talipes equinovarus. The left, a talipes calcaneovalgus. Both feet are smaller than is usually found in infants of that size. Right foot has the fifth toe overlapping the third, and the fourth is lying under the third. No spina bifida.

Radiographic Findings: Right hand shows normal radius and ulna. Thumb has a metacarpal and two phalanges, but the terminal is much smaller than normal. Index finger shows metacarpal and three phalanges; the rudimentary finger, metacarpal and three phalanges, but they are all much smaller than those of the index finger (Figs. 6 and 7).

Left hand has a radius which is curved to the radial side and shorter than the right. There is also a little round piece of bone near upper end of radius, which is the only part of the ulna present. Thumb and index finger seem to have the normal number of phalanges, but are somewhat smaller (Fig. 8).

Discussion: With regard to the etiology in these cases, we agree with Steindler[1] who sums it up as follows: "While as a whole, the theory of

FIG. 5
Left hand. View from above.

embryonal aberration or primary aberration covers the greater part of the cases of congenital malformations of the hand and fingers, it seems certain that other factors also come into play and that no one theory is capable of covering even the large majority of cases of congenital malformations".

Proper Placing of This Case in the Classification: The proper classification of hand deformities is difficult on account of the complications frequently found. This patient has, as noted above, deformity of the left forearm in addition to the fingers. The club-foot deformities in this case are not considered in this discussion. We will however attempt to put this case in the classification commonly used. Using the general terms of marginal, central, or terminal defects, this case is the central type on account of absence of the metacarpals.

Steindler[1] follows the classification of Potel. According to that discussion this case falls in the division of Ectromelia which is characterized by the presence of aborted or imperfect limbs. In the further subdivision of Ectromelia we find Transverse Hemimelia,—*i.e.*, deficient or atrophied forearm (legs and feet) or hands with normal upper arms and thighs. In the further subdivision of Hemimelia we find Ectrodactylia,—*i.e.*, absence of one or more of the entire fingers including the metacarpals. The case also belongs to the subdivision Longitudinal Ectromelia on account of absence of ulna. It is therefore a case of ectro-

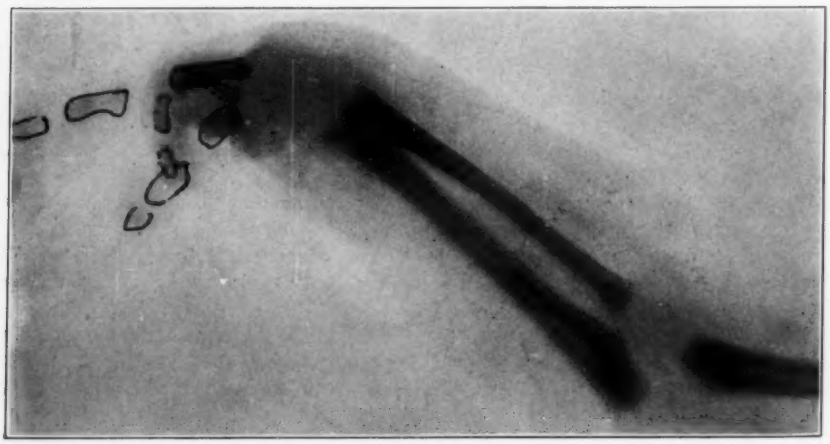

FIG. 6
Radiograph of right hand. (Retouched)

FIG. 7
Radiograph of right hand. (Retouched)

melia transverse hemimelia (bilateral) ectrodactylia plus longitudinal ectromelia (unilateral).

Steindler[1] uses also a simpler clinical classification with which this case coincides, as follows:

"*A*. Deformities by developmental suppression, agenesis.

1. Congenital defect of the forearm bones (congenital club-hand)
2. The cleft hand (lobster-claw hand)
3. Ectrodactylia (aphalangism)"

It is therefore in group 3 of *A*-bilateral and 1 of *A*-unilateral.

The term oligodactylia means deficiency of fingers (not absence). On account of the deficiency of muscle power and bony changes in the ring finger of right hand, this case can also be properly placed in that category.

In discussing ectromelia, Jansen (quoted by Lewin[2]) says: "The question remains unchanged, although exposed to the same tension. In the extremities the cartilage develops later than in the trunk; when in the sixth week the cartilage has been formed in the spine, the skeleton of the limb-buds still consists of that dense connective tissue known as scleroblastema. And it is easy to imagine a pressure which is able to affect the latter, fixed between amnion and trunk, to drive the blood out of them either partly or wholly, depriving them of their nutrition, whilst the skin as an older formation and in a condition of less active growth is little or not affected.

"The lower extremities, more exposed by their position and, moreover, backward in development compared with the upper, suffer most; and their button-shape seems to still bear the stamp of the direction in which the

FIG. 8
Radiograph of left hand. (Retouched)

amnion pressure has acted. The upper extremities, affected more indirectly by the hour-glass-shaped narrowing, to which every distended elastic bag tends in the middle of its length, are pressed against the trunk. A disturbance of the circulation in a space of two millimeters here means destruction of the peripheral half of the extremity. And the conical shape of the surviving stump seems to indicate that the disturbance of circulation gradually diminishes from the periphery to the center.

"The injury which the amnion may cause to the embryo is:

(1) greatest in the stage of the non-differentiated mesoderm,—*viz.*, in the first two weeks (the first stage of development of the skeleton);

(2) less in that of the dense scleroblastema, from the third to the sixth or eighth week (the second stage of development of the skeleton);

(3) least after the eighth week, when the whole of the skeleton consists of cartilage and bone (the third stage of development of the skeleton).

"It may be considered probable that the amnion has the power of destroying deep-lying parts in a perfectly normal embryo, either with or without a simultaneous injury to the skin. The same direct pressure which is unable to deform cartilage may compress scleroblastema, squeeze the blood out of it, and deprive it of its nutrition. If the cartilage stage is that in which various forms of kakomelia may arise, the beginning of the cartilage stage is specially fitted to cause various forms of kakomelia in which bones are lacking."

Acknowledgment: The child was born on the Obstetric Service of Fordham Hospital. The Director of the Service, Dr. J. Telfair, allowed the writer to make a study of the case and report it. Thanks are due him for his kind permission and valued assistance. The author wishes also to thank Dr. H. Hirsh, the radiologist of Fordham Hospital, for his careful x-rays.

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A BRACE FOR FOOT CORRECTION IN CHILDREN

BY EARL D. MCBRIDE, M.D., F.A.C.S., OKLAHOMA CITY, OKLA.

The merits of this brace lie chiefly in its adaptability to very early childhood. It was developed through an effort to secure a corrective agent that would be more permanently effective than modified shoes and less objectionable than braces made entirely of metal.

MODIFIED SHOES

Corrective changes that are a part of the shoe diminish in value as the shoe loses its original snugness, and with most children this is a rapid and variable process. A removable appliance is more desirable because its corrective features may be maintained independently of the shoe, and parents are more responsive in obtaining adjustment and repair.

METAL BRACES

Metal braces are objectionable especially in young children. The brace herewith described firmly establishes a corrective attitude; yet it is flexible, comfortable, and harmless. It may be employed very effectively in children with pronated or everted feet, even at the early walking period.

ACTION OF EACH UNIT

The metal heel plate has two important parts—one, the outer flange that grips the heel, similar to the Whitman brace; and the other, an anterior tongue which curves upward under the astragaloscaphoid articulation and produces a leverage action on this joint when weight is thrust upon the heel. The lug of sole leather under the inner border of the metal plate provides the "tilt" of the os calcis. The sponge rubber under the arch of the foot covers the metal tongue of the heel plate and acts as a "shock absorber" as well as an additional force in supinating the foot.

FIG. 1-A

FIG. 1-B

Type of case where brace is indicated.

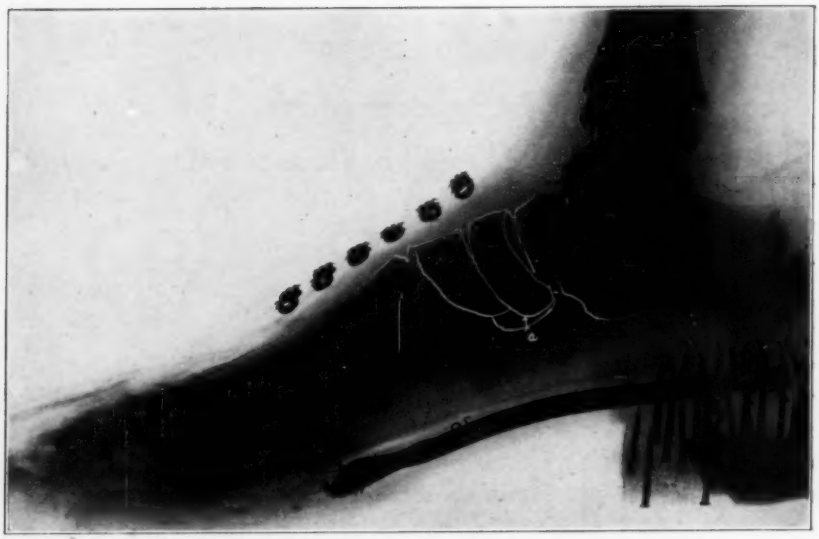

FIG. 2-A
Lateral view of stance without brace.

FIG. 2-B
Lateral view of stance with brace. Note rotation of astragaloscaphoid articulation at arrow *a*.

FIG. 3-A

Anteroposterior view of stance with brace.

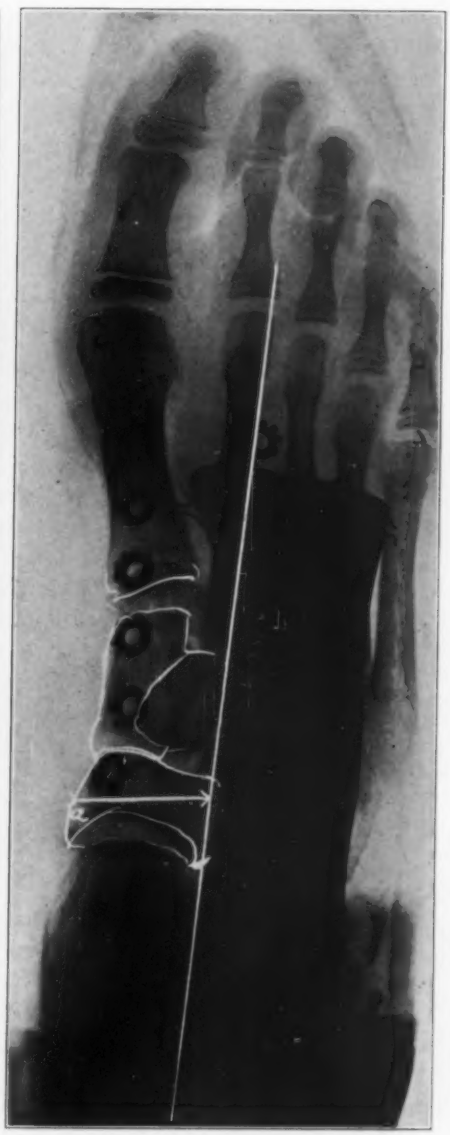

FIG. 3-B

Anteroposterior view of stance without brace. Note bulging of astragaloscaphoid articulation at *a*.

ADJUSTMENT OF BRACES

The brace should be "serviced" and readjusted as frequently as once a month in order to maintain proper posture and correction. It is necessary for the surgeon to have on hand some sponge rubber, a piece of sole leather, and some rubber cement. The sponge rubber or leather lug is all that need be adjusted and this is accomplished by separating the glued parts and recementing them when changes are made.

DETAILS IN CONSTRUCTION

Plaster Impression: The foot impression is made by the plaster-bandage and lead-strip method, because the child is often small and unruly.

The heel is made of German silver, duralumin, or monel metal. The metal part extends from the back of the heel to the astragaloscaphoid joint. It tapers from a narrow anterior tongue in front to the width of the heel behind, with an outer flange extending upward over the curve of the lateral border of the heel. This plate must be no wider than the insole of the shoe. Two rivet holes are made—one in the tip of the anterior tongue, and the other at the back near the inner posterior border of the heel plate.

Forepart of Brace: A thin piece of sole leather forms the basis of the forepart of the brace. It extends from the back of the heel to the base of the big toe and is shaped to fit the outline of the shank of the shoe. The posterior border tapers obliquely from the rivet hole on the inner posterior corner of the heel plate to the anterior edge of the outer flange. The anterior border tapers obliquely from the base of the big toe to the base of the little toe and is exactly as wide as the insole of the shoe at this point.

FIG. 4
Method of making plaster impression.

Pocket for Adjustable Lug: When this leather part is riveted to the metal plate, a pocket is formed between the metal and the leather, into which a lug of sole leather is placed. This lug should be about one-half inch in thickness on the metal side and taper out thinly to the outer side. The thickness will vary according to the amount of tilt it is desired to give to the heel. The lug is held in position by use of rubber cement. Stitches or rivets should not be used.

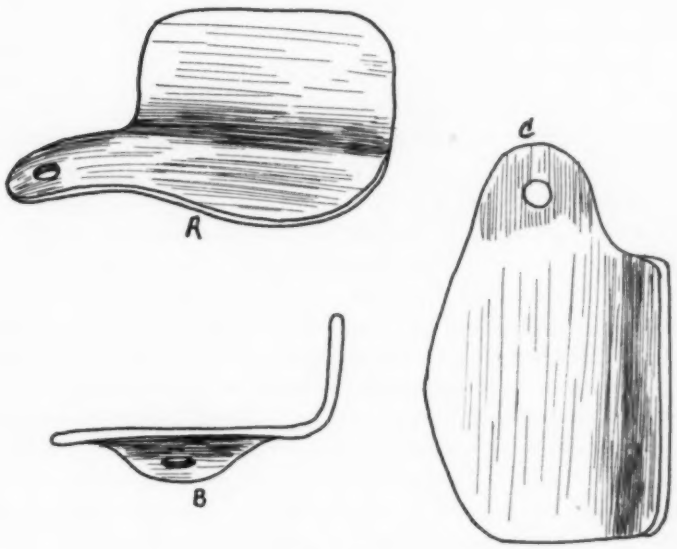

FIG. 5

Three views of metal heel plate. *A*. Inner lateral aspect; *B*. Posterior view; *C*. Top surface appearance.

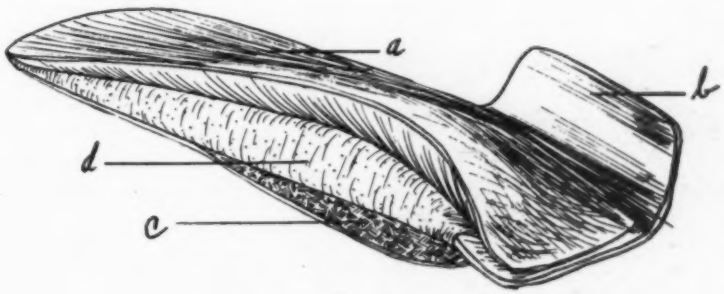

FIG. 6

Lateral view of inner border of the brace. *a*. Leather cover. *b*. Metal heel flange. *c*. Sole leather lug. *d*. Leather covered sponge rubber.

Felt Cushion: A wedge of sponge rubber is prepared to cover the anterior tongue of the metal part. It extends forward to the base of the first metatarsal and backward to the beginning of the prominence of the heel, conforming to the contour of the arch.

The upper surface of the whole brace is covered by very thin calf leather secured by rubber cement. The inner border of this leather cover should extend about one-half inch over the inner edge of the rubber pad.

CHRONIC OSTEOMYELITIS

Operation with Large Drill and High-Speed Motor*

BY ARTHUR D. KURTZ, M.D., F.A.C.S., PHILADELPHIA, PA.

Associate Professor of Orthopaedic Surgery, Temple University Medical School

The treatment of chronic osteomyelitis has occupied a prominent place in surgical literature, the majority of the contributions dealing with the treatment of the bone after operation. The suggestion of Dyas[1] that a dental engine and large burr had many advantages over the usual concussion instruments in acute osteomyelitis, has not been applied to the chronic type. Albee[2] discusses the advantage of high-speed saws over concussion instruments. The principles that apply to removal of a bone graft are multiplied when a long continued sequestrotomy is contemplated.

Fig. 1

Observations made over a long period of years in bone operations have verified the fact that bone concussion is productive of shock, and that the latter is in direct proportion to the former; pulse rate is increased by bone concussion and the amount of shock can be foretold by the amount of increase in pulse rate. Other factors are hemorrhage and long continued anaesthesia; but the principal offender is bone shock or jar. Another factor that may be commented upon is the difficulty experienced in removing all of the diseased bone with concussion instruments, fracture not being uncommon.

Eleven years ago, after the loss of a patient by a comparatively rapid sequestrotomy with concussion instruments, Dr. Harry Hudson suggested the use of drills in the high-speed surgical motor. Two large drills were obtained and fitted to our motor and have been used in over eighty cases of chronic osteomyelitis in the years that have followed. Nothing would be gained by reporting these cases separately as there is a monotonous similarity. Recurrences have been few and occurred prior to the adoption of the Orr technique.

*From the Orthopaedic Department of the Medical School of Temple University, Philadelphia.

The immediate operative procedure is as follows: a tourniquet is applied; a long incision giving free exposure is made; the periosteum is separated and retracted, the bone is opened by a drill attached to the surgical motor, the hole being made at right angles to the bone; the drill is then held at a thirty-degree angle to the bone, and the opening enlarged until the entire cavity is exposed. The cavity is then cleaned with curette followed by normal saline lavage, wiped dry with gauze, and saucerization with the drill is done; pockets are treated with the rose drill and the bone rendered smooth; a final lavage is given; and the tourniquet is removed. The Orr technique is then followed. We have now used the femoral neck drill on two occasions when our regular drills were not at hand. It has been found that one may remove most of the shaft of a long bone in twenty to thirty minutes, smaller areas in proportionately less time. We insist upon the cavity being as dry as possible, so that the bone may be slightly burned by the drill.

The manifest advantages over other forms of attack need no comment, but another phase requires consideration. Dyas[1] questions, "Do the heat and friction generated by the rapidly revolving burr kill the pus-producing micro-organisms?" All the clinical evidence favors an affirmative reply, with the addition that the heat tends to seal the bony canals and produce an increased reaction in the bone.

To summarize: A large drill attached to a high-speed surgical motor offers a rapid and ideal method of attack in chronic osteomyelitis. Time of operation and anaesthesia is shortened; hemorrhage is reduced to a minimum, with absence of bone concussion. Therefore shock is absent or almost nil.

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INTERLOCKED WIRE LOOPS TO CONVEY TENDON OR FASCIA THROUGH DRILL HOLES IN BONE

BY FREMONT A. CHANDLER, M.D., CHICAGO, ILL.

The following technique has resulted in the saving of much time and patience in passing transplanted tendons or fascial sutures through drill holes in bone.

FIG. 1

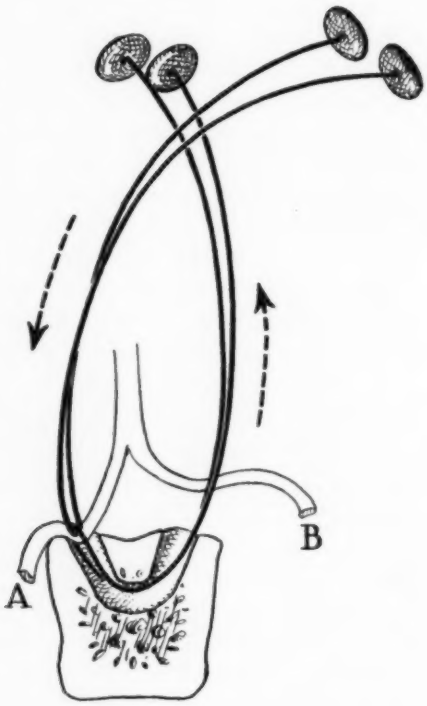


FIG. 2

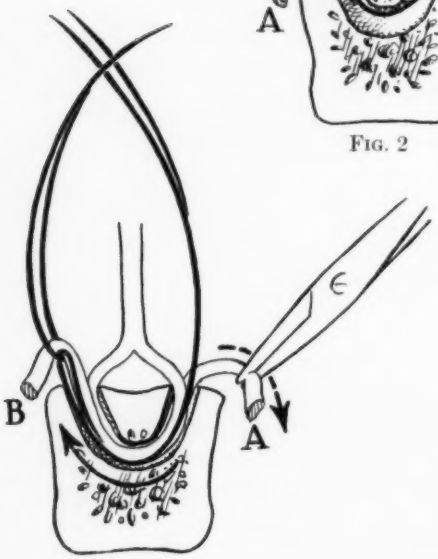


FIG. 3

FIG. 4

Wire such as is used in tonsil snare instruments is cut into lengths of twelve or fourteen inches. The cut ends are looped at right angles and are covered with a large drop of solder to prevent the puncturing of the operator's gloves and to provide a handle for traction (Fig. 4). The wires are then acutely bent at their centers. To facilitate the passage of this loop through angulated tunnels in bone (Fig. 1) the wire may be shaped into any desired curve. After the loop emerges from the tunnel exit, it is opened and interlocked with a similar wire from the opposite direction. The free end of the tendon is carried through the loop about one inch. As the wire is withdrawn the tendon folds back upon itself as it advances through the drill hole. Loop number two may be used to convey tendons from the opposite direction or to withdraw the first loop for a second trial (Figs. 2 and 3). The wire does not occlude the drill hole and permits the passage of the tendon from either or both directions.

A SIMPLE ANKLE TRACTION DEVICE FOR USE WITH THE FRACTURE TABLE

BY RUDOLPH S. REICH, M.D., F.A.C.S., CLEVELAND, OHIO

Frequently the problem of applying traction for the reduction of the fracture of one or both bones of the lower leg with the aid of the Hawley or Albee table presents itself. It is often necessary to enclose the traction cuff around the ankle in the plaster-of-Paris cast, and this procedure entails the task of cutting out lateral or dorsal windows for its removal, thereby impairing the efficiency of the plaster-of-Paris splint. The writer has devised a type of traction which can be covered with the plaster-of-Paris bandage and removed with facility, without the necessity of cutting away any part of the cast.

FIG. 1

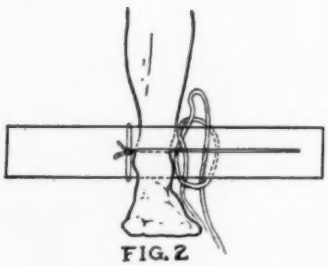


FIG. 2

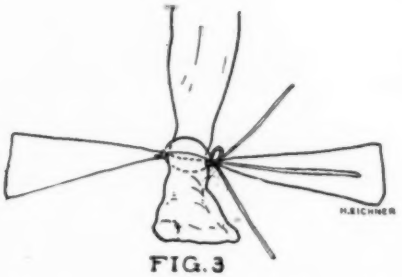


FIG. 3

A piece of strong flannel or muslin bandage one yard in length and four inches wide is employed. Starting at a point approximately sixteen inches from one end, the strip is slit longitudinally down the center toward the opposite end for a distance of eighteen inches (Fig. 1). This loop is then placed over the ankle next to the skin. In order to prevent the closed end of the strip from splitting further under tension, or from producing a wide

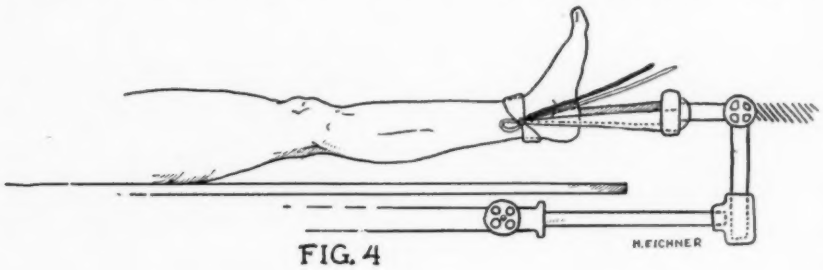


FIG. 4

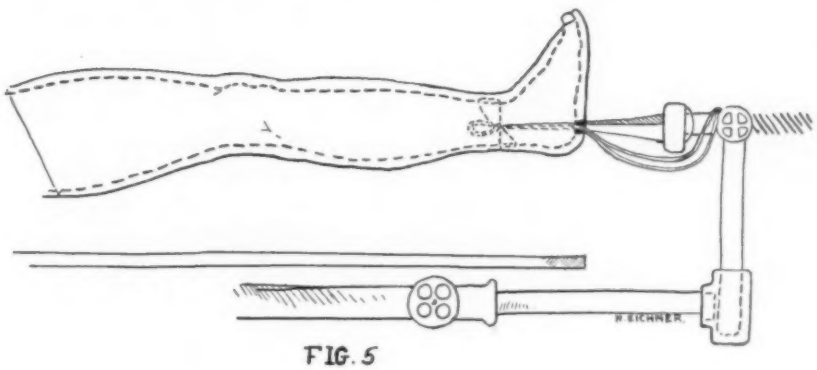


FIG. 5

gap in the cast, the point near the center where the slit begins is tied tightly together with a piece of two inch gauze bandage (Figs. 2 and 3). By tying a single bow knot with another strip of gauze bandage approximately one yard long, the loop is adjusted snugly to the ankle joint. The traction strap is now applied to the beam of the table employed, and the gauze bandage ends extending from the bow knot are draped around the beam close to the traction strap, and the plaster-of-Paris bandage is applied (Figs. 4 and 5), with the padding over the traction strap. Some talcum powder over the ankle assists the flannel or muslin to slip out more easily.

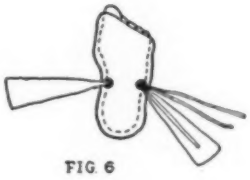


FIG. 6

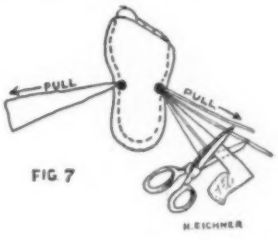


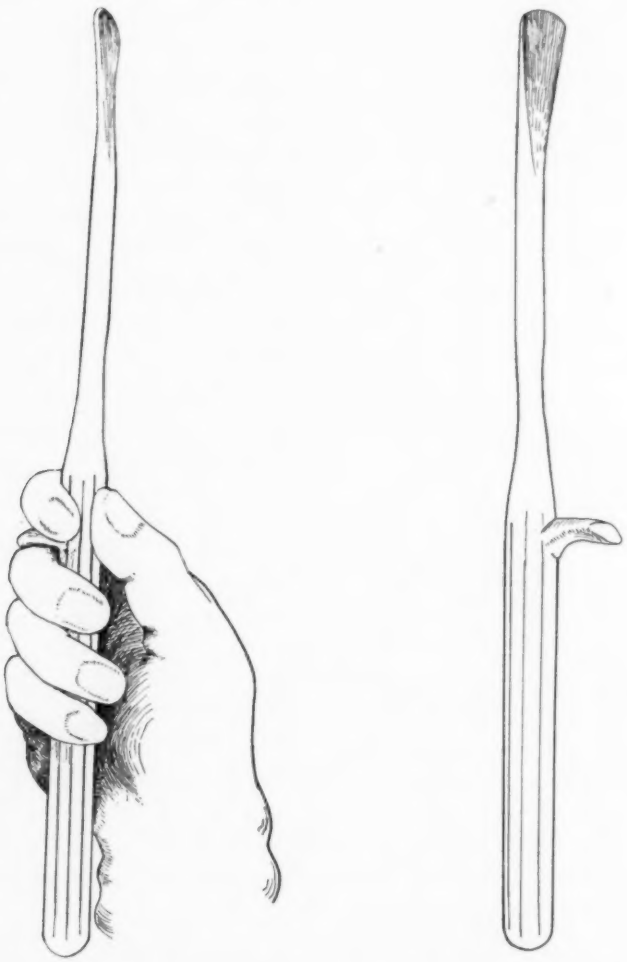
FIG. 7

When the plaster has sufficiently set, the traction strap is released from the beam, and the ends are slightly freed at their points of exit from the cast (Fig. 6). Then taking the two ends of the gauze bandage in either hand and gently pulling, the single bow knot is easily untied and that side of the traction strap which is split in two is cut off near its exit from the cast (Fig. 7). Then pulling the other end of the strap firmly but cautiously, it is extracted on the opposite side with very little difficulty. The points of exit may be sealed if desired.

MODIFIED STRAIGHT PERIOSTEAL ELEVATOR

BY GEORGE E. JOSEPH, M.D., ST. LOUIS, MO.

While working with a slippery, blood-covered periosteal elevator, have you ever wished for one that would not have to be held so firmly?

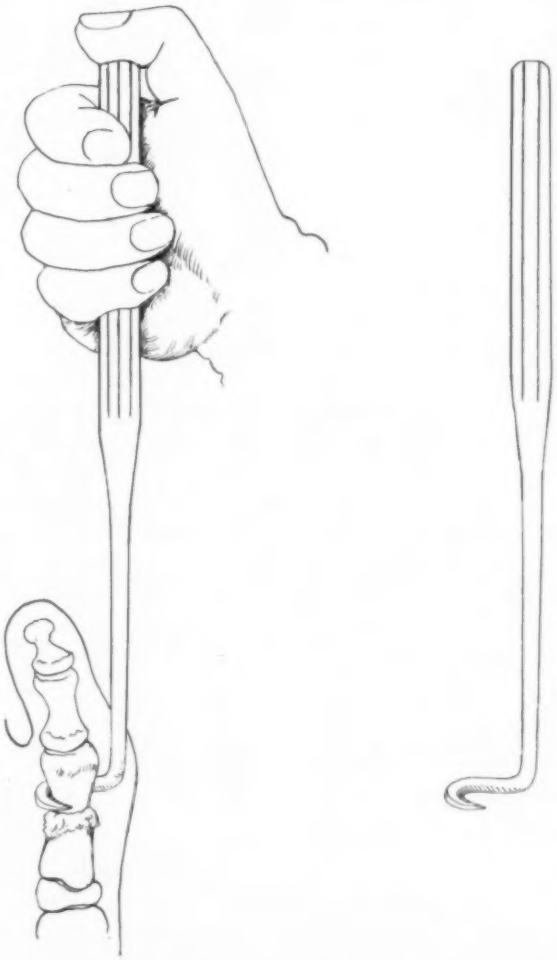


The accompanying illustration shows an instrument which seems to meet this condition. The lug placed upon the under side of the instrument fits between the index and middle fingers, thus stabilizing, while at the same time affording something against which to push.

RIGHT-ANGLE PERIOSTEAL ELEVATOR

BY GEORGE E. JOSEPH, M.D., ST. LOUIS, MO.

After experiencing considerable delay and inconvenience in denuding small rounded bones, such as the metatarsals, with the ordinary periosteal elevator, it occurred to the writer that what was needed was a self-retained instrument,—*i.e.*, one that would hug the shaft of these bones without slipping.



The accompanying drawing shows such an instrument with its semi-sharp, curved portion set at right angles to the shank. When used in the correction of extensive toe deformities where the metatarsal heads are resected, the instrument serves a double purpose,—*viz.*, retractor and guide as well as periosteal elevator.

AN OPERATION TO IMPROVE THE CONDITION OF HANDS DISABLED BY PARALYSIS OF THE OPPONENS POLLICIS

BY RALPH R. FITCH, M.D., F.A.C.S., ROCHESTER, NEW YORK

A man with a crippled leg can much more readily make his way in the world than can one with a crippled arm. In spite of this fact, much more attention has been given to ameliorating the condition of partly paralyzed legs and feet than has been given to similarly disabled arms and hands.

One of the most crippling deformities of the hand is occasioned by paralysis of the opponens pollicis. Paralysis of this muscle is often found in a hand having normal flexion and extension of the distal phalanx of the thumb and of all of the phalanges of the fingers. Paralysis of this muscle alone causes a high percentage of disability of the hand, since the thumb and fingers cannot be approximated.

About five years ago the writer decided to ankylose the first carpometacarpal articulation, with the hope of holding a thumb with paralysis of the opponens pollicis in a useful position. In the course of this operation the proximal end of the first metacarpal was dislocated posteriorly. At that point it was noticed that the thumb was lying in a very advantageous position. The decision was made to stabilize the thumb as it lay. This was done by passing a piece of kangaroo tendon* through a drill hole in the end of the metacarpal and attaching it to the dorsal surface of the os magnum. The normal abode of the end of the metacarpal was obliterated by filling it in with soft tissue to guard against the return of the metacarpal should the kangaroo fail to hold. The wound was closed and a splint applied to protect the thumb in its new position. The splint was worn for ten days, after which active motions were permitted. An exceedingly useful hand resulted.

Several similar thumbs have been operated upon in this manner with gratifying results in all.

*Fascia lata was used in later cases.

RUSTLESS STEEL WIRE
A NEW ADDITION TO THE SURGEON'S ARMAMENTARIUM

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Eminent authorities, among whom is Sir Robert Jones, are of the opinion that the greater one's experience is in the treatment of fractures, the less often will he resort to the use of open operation and internal fixation. In this view the writer heartily concurs, but with certain reservations. Surely the open reduction and internal fixation of a transverse fracture of the patella or olecranon process of the ulna, with separation of the fragments, yield better anatomical and functional results than conservative treatment. No one would venture to suggest that the end results of conservative treatment of a dislocation of either the sternal or acromial end of the clavicle can in any degree approximate the end results accomplished through open reduction and fixation, whether it be through the use of wire, silk, catgut, or fascia. The author does not intend to enter into a discussion as to which fractures should be treated by conservative methods and which should be treated by open reduction and internal fixation. He does, however, desire to call attention to a new addition to the surgeon's armamentarium,—namely, rustless steel wire,—use of which, as far as he has been able to ascertain, is original with him, in America at least.

Most of us have experienced keen disappointment by having the ordinary steel or silver wire break at the knot, and in most instances the wire has been inserted with much difficulty. Kangaroo tendon is notorious for breaking at the knot.

Recently the writer commenced to use rustless steel wire in the operative treatment of certain fractures and dislocations. This wire may be procured in various gauges, has advantages over silver or ordinary steel wire, the chief advantage being the fact that rustless steel wire is quite flexible and the ends may be knotted with a reasonable degree of twisting force without breaking.

Rustless steel wire is produced in various gauges and degrees of hardness. The heaviest size that the writer has used is .03 inch in diameter. A hard wire in this size is preferable for heavy work. This hard, .03 inch size is still flexible, being but slightly less so than silver wire of similar gauge, but much more flexible than the ordinary steel wire of similar gauge. This wire is very strong, its breaking point being at 100 pounds. In size it is approximately that of a strand of No. 3 catgut. A wire of this particular size and hardness is of use particularly in the internal fixation of

long spiral fractures of the femur and tibia, and also to secure fixation in arthrodesis of the knee, in lieu of metal plates, screws, etc.

A smaller size would suffice for other bones. The finest rustless steel wire that can be recommended is a soft wire, size .013 inch in diameter. This is very flexible, corresponding both in size and flexibility to a strand of fine silkworm gut, and being considerably more flexible than either silver wire or ordinary steel wire of similar size. This size (.013 inch, soft) is recommended for use in the operative treatment of the smaller bones, especially in fractures of the radius and ulna. As stated, this very fine flexible wire is quite strong for its size; its breaking point is at twenty-two pounds. This wire can also be used as a figure-of-eight suture to hold together the edges of a deep wound and, being very flexible, can be tied almost as easily as silkworm gut.

After healing of the wound the wire sutures are removed in the usual manner, as this wire is thin and soft and can be easily cut with a pair of ordinary scissors.

The employment of a small amount of wire has a great advantage over the use of a metal plate or metal screws because the wire does not act like a large foreign body, nor does it produce more than a fraction of the pressure or irritation that accompanies the use of metal plates or screws. Further, should infection set in, the wire may be left in until its usefulness has been served, or at least for a considerably longer time than one would care to permit a metal plate to remain. Then, too, the writer feels that the incidence of delayed union or non-union would be considerably less than in cases where metal plates had been used.

Whether or not rustless steel wire should be permitted to remain permanently, after the purpose of its employment has been served, is a matter of opinion which must be judged by its behavior in the tissues.

News Notes

Just as *The Journal* goes to press, word has been received of the death of Mr. T. H. Openshaw, C.B., C.M.G., of London, on November 17. Mr. Openshaw was one of the original members of the British Orthopaedic Association.

Dr. Arthur T. Legg announces the removal of his office to The Longwood Medical Building, 319 Longwood Ave., Boston, Mass.

Dr. N. Austin Cary and Dr. Leonard Barnard announce their association for the practice of bone and joint surgery, with offices at 2939 Summit St., Oakland, Calif.

Dr. Peter M. Keating has moved his office to 201 East Laurel St., San Antonio, Texas.

Word has just been received that Dr. Arthur Steindler, of Iowa City, a member of the Advisory Editorial Staff of *The Journal*, has been elected to membership in the Deutschen Orthopädischen Gesellschaft.

Dr. M. N. Smith-Petersen has been appointed Chief of the Orthopaedic Service of the Massachusetts General Hospital, succeeding Dr. Nathaniel Allison, who has resigned to accept the appointment of Professor of Surgery of the University of Chicago.

Dr. Fred H. Albee, of New York City, was recently made Honorary Corresponding Fellow in Orthopaedic Surgery of the Royal Medical Society of Great Britain.

Dr. Harry Goldberg, formerly associated with Dr. Arthur Steindler's Clinic at the Children's Hospital, Iowa City, Iowa, has opened an office at 701 Heyburn Building, Louisville, Ky.

Dr. Hugh Jones is now associated with Dr. Ellis Jones in the practice of orthopaedic surgery at 1136 West Sixth St., Los Angeles, Calif.

The *Editor* of *The Journal* was recently honored by election as Honorary Member of the Czecho-Slovakian Orthopaedic Society.

Of special interest are the new courses in physiotherapy introduced this year at **The College of William and Mary in Virginia.** Provisions have been made for a limited number of students in the School of Physical Education of the college, to obtain a B.S. degree in four years with a major in physiotherapy. These courses in physiotherapy are given under the direction of Dr. Thomas Wheeldon, of Richmond.

The forty-fourth meeting of the **American Orthopaedic Association** will be held June 18 to 21 inclusive, 1930. This will enable the members to attend the meeting of the American Medical Association, held in Detroit beginning June 23, 1930.

There will be one day, June 18, devoted to Clinics in Boston. On the morning of June 19 the members will visit Lakeville Sanatorium, a collection of 200 cases of surgical tuberculosis, proceeding that afternoon to Chatham, on Cape Cod, where a scientific session will be held that evening. June 20 and 21 will be spent at the Chatham Bars Inn, and devoted to scientific and executive business, and recreation.

The Ninth Annual Convention of **The International Society for Crippled Children, Inc.**, will be held in Toronto, Ontario, March 17, 18, and 19, 1930. The convention will be held at the Royal York Hotel, and meets under the patronage of the Governor General of Canada and the Viscountess Willingdon. The program is of unusual interest, and includes such speakers as the Honorable G. Howard Ferguson, Premier of Ontario, and the Honorable Franklin D. Roosevelt, Governor of New York. Dr. W. E. Gallie, of Toronto, Chairman of the Professional Advisory Committee, will give the key-note address on "Bridging the Gap".

Further information about the meeting may be secured from Sydney B. McMichael, Chairman of the Toronto Convention Committee, 92 W. Adelaide St., Toronto, Ontario.

At the meeting of the Executive Committee of the **British Orthopaedic Association** on October 2, the following were elected as Associate Members:

Miss M. I. Meacock, Bronhavren, Stow Hill, Newport.

John B. Colquhoun, University Union, Edinburgh.

N. Ross Smith, West Moor, 9 Poole Road, Bournemouth.

At the annual general meeting, held in Leeds on October 18, the following were elected as Associate Members:

Miss K. A. Muir, Wingfield Orthopaedic Hospital, Headington, Oxford.

J. Gibson Craig, O.B.E., Low-royd, St. Olave's Road, York.

At the meeting of the Executive Committee on November 26, there was elected as Full Member:

Mr. J. F. Brailsford, 20 Highfield Road, Edgbaston, Birmingham.

At the annual general meeting, held in Leeds on October 18 and 19, officers for the year 1930–1931 were elected as follows:

Emeritus President: Sir Robert Jones, Bart., K.B.E.

President: R. C. Elmslie.

Vice-President: H. Platt.

Hon. Treasurer: W. R. Bristow.

Hon. Secretary: A. S. B. Bankart.

Editorial Secretary: G. Perkins.

Mr. George Perkins has served as a member of the Advisory Editorial Staff of *The Journal* during the past year, and now succeeds Mr. Harry Platt as Editorial Secretary. Mr. Platt has been associated with the work of *The Journal* in this capacity for many years, and has given valued service to *The Journal*.

The Journal for April 1928 carried the announcement from the **New York Orthopaedic Hospital** of the Annie C. Kane Fellowships, which make it possible for certain selected young surgeons who have completed medical course and internship to continue their training at the New York Orthopaedic Hospital. The fund became operative in January 1928, and since that time six Fellows in Orthopaedic Surgery have been appointed for periods of three years, as follows:

Dr. Joseph C. Risser, Des Moines, Iowa.

Dr. M. Beckett Howorth, West Point, Miss.

Dr. Halford Hallock, Fort McPherson, Ga.

Dr. Walker E. Swift, New York, N. Y.

Dr. Harold W. Smith, Campbell, N. Y.

Dr. Leonidas A. Lantzounis, Meligala, Greece.

The Hospital for Joint Diseases, New York, announces the following House Staff appointments to be made during the coming year:

Two on the Orthopaedic Services beginning January 1, 1931, for eighteen months each, open to those who have had a year's intern training.

Five on the General Service beginning July 1, 1930, for one year, including two months of orthopaedic surgery. Appointees to the General Service are eligible at the

end of the year for selection to continue for six months as House Surgeon on that service or for eighteen months on the Orthopaedic Service.

Graduates of the House Staff of the Hospital for Joint Diseases are eligible to the following Scholarship and Fellowships awarded annually:

1. The Frauenthal Travel Scholarship of $2400 a year for study in the leading clinics of Europe and the United States.

2. The Mr. and Mrs. Frederick Brown Research Fellowships, with an income of $4800, providing an award of $2400 each to two successful candidates.

Applications for appointments to the House Staff should be addressed to Dr. Walter M. Brickner, Attending Surgeon, Chairman of the House Staff Committee.

The semi-annual meeting of the **Minnesota Orthopaedic Club** was held in Minneapolis on November 1 and 2. There were ten members present at the dinner which was followed by an informal discussion of the tours of the various clinics of Europe and the British Isles. Papers presented by the various participants in the joint program of the American and British Orthopaedic Societies were discussed freely.

Following this informal discussion, Drs. Evans and Henry presented an outline of percentage ratings of the disabilities of upper and lower extremities for compensation purposes. The discussion following demonstrated the interest in this particularly difficult problem.

The next morning the meeting was held in the Shriners' Hospital, where a number of cases were presented and discussed. The results of the open and closed method of treatment of congenital dislocation of the hip were demonstrated and the merits discussed. Non-union following fractures of the lower end of the tibia, transplantation of the flexor muscles of the forearm to the more proximal position of the humerus after the method of Steindler, and other interesting cases were shown.

The Eastern States Orthopaedic Club met in Philadelphia on October 28, 29, and 30. The clinical program was as follows:

Graduate Hospital, October 28—

Etiology of Perthes' Disease ..... Dr. George Wagoner
Arthritis ..... Dr. Ralph Pemberton
Case of Scapular Suspension ..... Dr. J. T. Rugh
Sheuermann's Disease ..... Dr. James E. Wyant
Postural Backs Treated by Exercise ..... Dr. J. B. Carnett
Demonstration of Postoperative Results for Tuberculous Arthritis of Hips—
Paralytic Varus Deformity of Foot ..... Dr. Walter Elmer
Keinböch's Disease ..... Dr. Howard Moore
Bone Sarcoma ..... Dr. DeForest P. Willard
With Discussion by Dr. George E. Pfahler

University Hospital, October 29—

Pathological Dislocation of Hip ..... Dr. A. Bruce Gill
Posterior Bone Block for Foot Drop ..... Dr. A. Bruce Gill
Anterior Bone Block for Calcaneus ..... Dr. A. Bruce Gill
Operation for Paralytic Back Knee ..... Dr. A. Bruce Gill
Statistics on Congenital Dislocation of the Hip ..... Dr. Leonard Frescoln
The Value of Radiation of Cod Liver Oil ..... Dr. Varum Southworth
Operation for Arthrodesis of the Shoulder ..... Dr. A. Bruce Gill
Arthrodesis of Hip for Ununited Fracture of Neck of Femur ..... Dr. A. Bruce Gill
Study of Series of Cases of Persistent Recurring Hydrops of the Knee ..... Dr. Theodore E. Orr
Operation for Spondylolisthesis ..... Dr. Theodore E. Orr
X-ray films of Some Interesting Cases ..... Dr. A. Bruce Gill

Orthopaedic Hospital, October 30—

Results of Treatment for Arthritis with Salihexin.....Dr. E. P. Corson White
Demonstration of Cast for Traction.....Dr. John Moore
Osteoperiosteal Bone Graft.....Dr. George Wagoner
Congenital Absence of Radius.....Dr. James E. Wyant
Case of Bone Graft with Absorption of Humerus.....Dr. Rutherford John
Perthes' Disease.....Dr. J. Snodgrass

The Bone and Joint Section of the **Southern Medical Association** held its annual sessions at Miami on Thursday and Friday, November 21 and 22. Twelve papers were presented covering a variety of subjects of orthopaedic interest.

Among the papers of unusual interest was one by Dr. A. R. Shands, Jr., Professor of Orthopaedic Surgery, Duke University, on the subject of "Synovial Fluid in Infectious and Neuropathic Arthritis".

Dr. Albert B. Ferguson, New York, member of the Staff of the New York Orthopaedic Hospital, was the invited guest of the Bone and Joint Section and gave a paper on "The Study and Treatment of Scoliosis", elaborating the principles of the treatment of this deformity as it is taught at the Hibbs clinic.

A paper was presented by Dr. Michael Hoke, Atlanta, describing an operation he has devised for the correction of extreme hallux valgus, and an operation with some of the same principles for the correction of metatarsal equinus with and without dislocation of the toes.

Dr. J. H. Kite, Chief Surgeon of the Scottish Rite Hospital, Atlanta, presented a very comprehensive paper on the non-operative treatment of congenital club-foot, with a review of one hundred cases showing end results.

Dr. J. S. Speed, of Memphis, read as the chairman's address a paper on the treatment of ununited fractures by bone grafts and showed in some detail results obtained at the Campbell clinic by the use of the autogenous onlay bone grafts and pegs.

New officers elected for the Bone and Joint Section were Dr. George E. Bennett, Baltimore, Chairman; Dr. O. L. Miller, Charlotte, N. C., Vice-Chairman; Dr. Allen Voshell, University of Virginia, Secretary. The next Annual Meeting will be held at Louisville, Kentucky.

MITCHELL LANGWORTHY

Dr. Mitchell Langworthy, orthopaedic surgeon, friend of humanity, contributor to human happiness, passed from this life on October 8, 1929. He was thirty-eight at the time of his death, and had practiced his profession in Spokane but ten short years. Ten years is a very short period when measured by the dial of time. But a human life must be measured by the happiness and sunshine created by the individual, and the worth of a life must be considered in terms of its survival value. Mitchell Langworthy's life was one continuous contribution to humanity and its survival value is found in his many contributions to Orthopaedic Surgery, in the untold friends he has left, and in the gratitude of the many hundreds of children whose lives have been blessed because of him. Seldom do we find in one individual such a combination of talents as were found in Mitchell Langworthy. He had most unusual ability as an orthopaedic surgeon; he had an unusual grasp of mechanics, especially as such mechanics related to his profession; he had many inventions to his credit—all for the relief of human suffering; he was a most entertaining musician; and with it all he made scores of friends, and he had no enemies.

Of him we may well say:

"None knew thee but to love thee,
None named thee but to praise."

The meeting of the **Clinical Orthopaedic Society** was held in Milwaukee on October 25, and in Madison on October 26. The program was divided into symposiums which were discussed by the one hundred members present.

Dr. J. W. Powers showed a short motion picture of his simplified method of doing a reconstruction operation on the hip joint for ununited fracture of the neck. A straight lateral incision is used; the great trochanter with attached muscles is removed with a curved gouge. After shaping up the upper end of the shaft slightly, it is manoeuvered into the socket and the trochanter is attached lower down with chromic catgut sutures. The results shown were good and the simplified technique recommended for poor risks.

Dr. H. C. Schumm presented cases of extra-articular fusion of the hip joint in which a graft taken from the lateral surface of the shaft is run through a bone slot, contacting with upper end of femur and ilium. Fusion was solid in cases shown.

A case of non-union at the center of the femur was shown by Dr. J. O. Dieterle. Patient is able to walk without apparatus because of contour of apposing surfaces and bony outgrowths. The knee is ankylosed in extension. A bone graft or other operation designed to get union was thought contraindicated because walking would be made more difficult.

Dr. F. J. Gaenslen presented a case of recurrent dislocation of the shoulder joint in which the Eden operation was performed. The bone block at the anterior inferior margin of the glenoid was successful in preventing recurrence of dislocation. Dr. Gaenslen also showed the anterior approach to the glenoid fossa on a cadaver.

Dr. L. D. Smith presented a rare case of tuberculosis of the semilunar cartilage. There was no evidence of bone destruction.

Dr. C. C. Schneider presented a short discussion of DeQuervain's disease, demonstrating methods of treatment by plaster cast after incising the sheath of the abductor pollicis longus.

A case of osteomyelitis of the os calcis was operated upon by Dr. Gaenslen by an incision through the plantar surface of the heel. By this method the os calcis is split through to the subastragaloid joint with a broad osteotome, the necrotic focus removed, and the cavity filled with vaselin. A cast is applied and the wound allowed to granulate. A scarred furrow forms in the center of the wound and when healed the patient walks on two heel pads.

The skeletal traction apparatus by Kirschner, in which rustless wire is driven through bone by motor-driven apparatus, was shown by Dr. W. P. Blount. This instrument is an improvement over the Steinmann nail.

In the evening program a film showing the reduction of fractures under novocaine anaesthesia as practiced in the Böhler clinic, Vienna, was presented by Dr. J. O. Dieterle.

The Board of Managers of the **Hospital for the Ruptured and Crippled,** New York City, passed the following resolution on the occasion of the resignation of Dr. Royal Whitman on December 1, 1929:

WHEREAS, Dr. Royal Whitman, after a continuous service of more than forty years, has seen fit to tender his resignation from the Hospital for Ruptured and Crippled, be it

RESOLVED that in accepting with deep regret the resignation of Dr. Whitman, the Board take this occasion for placing on record its appreciation and gratitude for the splendid service that Dr. Whitman has rendered the hospital during this long period of years.

Dr. Whitman came to the hospital unusually well fitted for the work he was to undertake. When he entered on his service, orthopaedic surgery was practically unknown; treatment consisted largely in the application of mechanical braces. Orthopaedic surgery at the Hospital for Ruptured and Crippled may be said to have been introduced largely by Dr. Whitman. Many new operations originated from his fertile brain; likewise many new operative methods of great value were introduced by him, the most

notable of which was the abduction method of treatment of fractures of the neck of the femur—a method that has been adopted practically all over the world.

With a remarkable capacity for work, Dr. Whitman devoted practically all his time and energy to the hospital, and much of the prestige of the Hospital for Ruptured and Crippled as an orthopaedic institution is undoubtedly due to him.

While distinguished as an orthopaedic surgeon Dr. Whitman will be remembered longest as a great teacher. Many students of the New York Polyclinic and the College of Physicians and Surgeons received their training under him, and a long line of house surgeons who came in intimate daily contact with him now occupy leading positions in orthopaedic surgery throughout the country. His textbook on Orthopaedic Surgery has been through eight editions, and is a standard authority in all medical schools.

In accepting Dr. Whitman's resignation as Attending Surgeon of the Hospital for Ruptured and Crippled, we trust he will remain interested in the welfare of the hospital and that he may be able to serve it for many years to come as a Consulting Surgeon.

British Orthopaedic Association

The British Orthopaedic Association held its Annual General Meeting in Leeds on October 18 and 19, 1929, under the presidency of Mr. Hey Groves.

At the morning session on October 18, the following short papers were read:

1. "Arthritis Arising in Connection with Non-Specific Infection of the Urinary Tract", by Mr. J. F. Dobson.

Stimulated by recent American experimental work, Mr. Dobson has of late commenced to investigate this problem. He quoted several instances of acute arthritis associated with or following the onset of cystitis, prostatitis, or pyelitis. The arthritis in every case rapidly subsided with the cessation of symptoms of the primary condition. On the other hand, examination of the urine of eleven patients with various forms of arthritis showed no pus and no growth on culture even after provocative prostatic massage.

In the discussion, Mr. Elmslie put forward the plea that in investigations undertaken to correlate a source of infection with an arthritis, the type of arthritis should be distinctly defined. Mr. Hey Groves wondered whether the so called gonococcal arthritis was due to the gonococcus or whether it only occurred when the urethritis was due to a mixed infection.

2. "A New Antiseptic—488", by Mr. G. Armitage.

Mr. Armitage described the results obtained by this new antiseptic—anil-quinoline—which had been introduced by Professor Cohen. He stated that it was more bactericidal than acriflavine, was soluble in water and in alcohol, retained its bactericidal power in the presence of serum, and was of low toxicity. He said the substance would shortly be on the market.

3. "Congenital Fracture of the Tibia", by Mr. Howard L. Crockatt.

Mr. Crockatt described the clinical histories of five cases and emphasized the fact that the condition was due to a congenital failure of osteogenesis in the lower half of the tibia. In the subsequent discussion, the difficulty of securing bony union even after the insertion of a massive autogenous bone graft was emphasized; and on that account and because of the shortening of the limb, which was always present, many members advocated early amputation as the most rational line of treatment.

4. "Renal Rickets", by Messrs. Towers and Tunbridge.

This paper was illustrated with slides and specimens, and several case histories were presented.

Mr. Platt commented on the absence of references to renal rickets in Continental and American literature; he thought the condition was perhaps endemic in Great Britain. There seemed to be two classes: one, very severe, showing obvious signs of the disease in early childhood, which were probably associated with congenital abnormality of the kidney (*e.g.*, polycystic disease); and the other, less severe, diagnosed near puberty by

the appearance of severe epiphyseal deformities, and associated with an acquired chronic nephritis.

Dr. M. H. Greg showed photographs of corrections obtained by the use of braces in the severe degrees of genu valgum associated with this condition. She also commented on the high percentage of blood urea in the patients under her care at a country hospital and who appeared to be in good health.

Mr. Fairbank confirmed the observation made by Dr. Greg that in these patients fractures of the shafts of the bones occurred (apart from juxta-epiphyseal fractures), and that they were often painless.

At the afternoon session on October 18, Mr. S. W. Daw showed a number of patients who had been treated for the following affections:

Dupuytren's contracture.

Some treated by multiple tenotomies, some by open dissection, and some by amputation.

Synostosis of the radius and ulna.

Three patients treated by resection of the upper part of the radius.

Tuberculosis of the elbow.

Three adults treated by excision of the joint.

Myositis ossificans.

Fracture of the upper end of the humerus.

Four patients, all treated by manipulative reduction. The arm was flexed at the shoulder ninety degrees and then adducted forcibly over the body, thus using the chest wall as a fulcrum to lever out the inwardly displaced lower fragment of the humerus.

Sprengel's shoulder.

One patient, treated by the removal of a large bony ridge running from the scapula to the spine.

Acromio-clavicular dislocation.

Three adults, treated by fascial suture.

Recurrent dislocation of the shoulder joint.

Four adults treated by a fascial sling running from the acromion to the head of the humerus.

Congenital dislocation of the hip.

One of these, a young adult with an unreduced congenital dislocation, walked well with a stable mobile hip after a bifurcation osteotomy of the femur.

At the morning session on October 19, cases showing the following conditions were presented by Mr. S. W. Daw:

Malunited Pott's fracture.

One patient, with a severe backward displacement of the foot unreduced for nine weeks. The dislocation was forcibly reduced under anaesthesia with the aid of an osteoclast.

Diaphyseal aclasis (Dyschondroplasia).

Congenital talipes equinovarus.

Extracapsular fracture of the neck of the femur.

Open fractures of the tibia and fibula.

Mr. Broomhead read a paper on, "Infections Arising out of the Use of Pin Traction". In one case out of forty-three, the track of the pin became infected and in this patient the pus tracked down subcutaneously from an infected open fracture to the pin. Cultures were taken in twenty-four other cases from the track after withdrawal of the pin, and in seventeen the cultures were sterile. Usually the skin openings remained dry throughout and those which were moist and from which growths were obtained quickly healed after withdrawal of the pin, and gave no trouble.

Interurban Orthopaedic Club

The thirty-third meeting of the Interurban Orthopaedic Club was held in New York on Friday and Saturday, November 15 and 16, 1929.

The first session was held at the New York Orthopaedic Hospital on Friday morning, November 15, and many cases representing the end results of fusion operations for scoliosis were shown by Dr. Risser. The results were extremely satisfactory. The failures to control the curve or to benefit the patient, Dr. Risser believed, had been due to (1) failure to fuse the primary curve or enough of the primary curve, (2) failure to gain the maximum pre-operative correction and (3) failure to protect the spine for a sufficiently long time following fusion, especially during the growth period. Dr. Hibbs has the strong impression that most of the cases of so called idiopathic scoliosis are due to an unrecognized poliomyelitis.

Dr. A. D. Smith showed the end result of the removal of a hemivertebra in a case of congenital abnormality of the spine which had been accomplished by the late Dr. Von Lackum in a two-stage operation. The hemivertebra had been successfully removed and the subsequent x-rays of the spine showed a very satisfactory correction of the congenital scoliosis.

Dr. W. H. Watters exhibited end results of fusion of the ankle joint for tuberculosis, the earliest one having been performed at two years of age. End results in many cases were demonstrated, showing apparently entire cure of the bone and joint lesions and extremely satisfactory function. It is important to fix the foot in very slight equinus to allow for the heel of an ordinary shoe. A surprising amount of compensatory motion had developed in the mediotarsal joints, so that the gaits in these cases were practically without limp.

Dr. Hibbs demonstrated about fifteen cases of the original twenty which he had reported at the 1926 meeting of the American Orthopaedic Association in Atlanta, in which his operation for the fusion of the hip joint in cases of tuberculosis had been performed. The impressive thing to be noticed in the x-rays was the complete healing of the tuberculous lesions of the joint proper, which had not been operatively attacked. He believed that the ideal position for ankylosis of the hip is in from fifteen to twenty degrees of flexion and not more than about ten degrees of abduction.

Dr. H. W. Smith showed the results of spinal fusion in young children for tuberculosis of the spine. The children had been selected to demonstrate the fact that fusion of the spine in early age does not interfere materially with growth in height. One case showed a growth of twenty-three inches in height in ten years; another seventeen inches in height in five years; another eleven inches in height in five years. One case which had had two fusions for two foci had grown twelve inches in four years.

Dr. A. D. Smith reported the results of exploratory operation in twenty-one cases of joint involvement in which the diagnosis as to tuberculosis or pyogenic infection was not absolutely clear. All these cases had proved to be non-tuberculous, but even at the time of operation the diagnosis could not be definitely made. In a majority of cases the joint fluid was excessive and usually clear, but the synovial membrane was often thick and grayish in color like that found in tuberculosis. He had found frozen sections made at the time of operations very helpful in making the diagnosis. The moral to be drawn from his careful study was that it is important not to fuse joints at the time of operation unless the diagnosis of tuberculosis is sure.

A report was given of an interesting study of the comparative cost in charitable and municipal institutions of the care of tuberculous joint lesions under palliative treatment, and under operative treatment of the nature of fusions. It was evident from this study that fusion operations on these cases materially hastened the return to wage-earning capacity in these cases and diminished the cost of the care of such patients.

The second session was held on Friday afternoon at the Hospital for Bone and Joint Diseases, and many interesting cases were shown. Dr. Kleinberg reported a new operation for overcoming the inward rotation of the arm in cases of Erb's palsy, consisting of an incision just below the head of the humerus, splitting the periosteum and stripping back the capsule, and a section of the cartilage of the greater tuberosity. The arm was outwardly rotated after these procedures, the tissues being held in the position of outward rotation. The results which he showed were excellent.

Dr. Joseph Buchman demonstrated satisfactory cures of recurrent dislocation of the shoulder by cutting the long head of the biceps tendon as it entered the groove, drawing it upward, dislocating the head of the humerus, boring a hole through the head to come out at the point of section of the tendon in the groove, and resuturing the tendon.

Dr. Walter Galland showed excellent results of the Lorenz bifurcation operation on the hip for hypertrophic arthritis and intracapsular fracture. He brought out the point that for successful motion to follow this operation, it is necessary that the head fragments have a considerable range of motion before the operation is performed.

Dr. Leo Mayer showed excellent end results from his transplantation of the trapezius to act as an elevator of the shoulder in cases of deltoid paralysis and a new operation for bone block in genu recurvatum.

The third session was held at the New York Post-Graduate Hospital on Saturday morning, November 16. Dr. Albee reported great satisfaction with the Orr treatment of osteomyelitis. Work was in progress, with the help of the bacteriologist of the hospital, which suggested that one of the factors conducive to the success of this treatment is the probable development within the wound of a bacteriophage, the infrequent dressings of the wound making such a development possible. He also demonstrated excellent results from the bone-peg operation in cases of ununited fracture of the neck of the femur, illustrating his technique and emphasizing the importance of using a large graft freshly removed from the tibia, containing all the important bone elements and fitting with absolute accuracy, but without undue tightness, into the path prepared for it in the neck and head fragment. He also showed the end results of his reconstruction operation on the hip joint, emphasizing the importance of the bone lever which he produces by splitting off the trochanter and the bone distal to it and maintaining the wide abduction of this fragment, or lever, by packing the angle with bone chips.

A most instructive discussion of bone tumors with lantern-slide demonstration was given by Dr. James Ewing, with special relation to the tumor which bears his name and which he calls diffuse endothelioma. He believes that in this type and in benign giant-cell tumors treatment by radiation has become the method of choice, both because of its safety and its success. He made the statement that every case of unexplained pain in a long bone, in spite of a negative x-ray, calls for a provisional diagnosis of bone neoplasm and for treatment at once by radiation. If a wrong diagnosis has been made, no harm will be done.

Dr. Charles Ogilvy showed an interesting case on the dislocation of the atlas on the axis with probable fracture of the odontoid. He showed excellent results in congenital flat-foot from arthrodesis of the astragalus and scaphoid bone.

German Orthopaedic Society

Twenty-fourth Meeting, held at Munich, September 16–18, 1929.

The congress of this year was opened by Prof. Hohmann, who gave a retrospective view of the problems and aims of scientific research in Orthopaedic Surgery. He pointed out that it would be a worthy task to write the history of Orthopaedic Surgery in order that all material written or spoken could be systematically collected and thus the work of the future investigator facilitated.

COXA VARA

The chief report on the *coxa vara* was given by Walther (Munich). The author distinguishes the idiopathic (congenital, static, adolescent) and symptomatic. Of the last group the coxa vara is either the sequela of a system-disease (rickets, osteomyelitis, osteitis fibrosa, chondrodystrophia, arthritis deformans), or the sign of a local lesion (Perthes', luxatio congenitalis coxae, tuberculosis, osteomyelitis, osteitis fibrosa); also sometimes the result of a trauma (fracture of the neck of the femur and infraction). For measuring the position of the collum femoris, it is advised to use the trochanter minor as the chief indicator, especially after the age of five years (the errors of the x-ray should be excluded). The Roser-Nélaton line has been generally abandoned, as it is not to be depended upon.

The most reliable guide is in the distance of the trochanteric prominence from the crest of ilium, measured by means of Martin's anthropometer. The first impediment to movement is found in the inflammatory stage and is the reflex muscular hypertonus. From the prognostic point of view the rachitic form is the most favorable, since it may be under general treatment and later completely healed, even though it is hardly to be differentiated from the static form. The congenital form is closely related to the partial defects of the femur, and is often associated with endocrine disturbances. In infants with slight symptoms there may be observed later the severe forms of shepherd's crook of the upper end of the femur. The most peculiar type is the coxa vara adolescentium, which attacks strong youths between fourteen and eighteen years of age, usually with no certain evidence of trauma. The clinical course resembles that of epiphyseolysis. Clinical signs are often late in appearance; the prognosis is markedly unfavorable. The cause of this yet obscure disease of the neck of the femur may be a primary defect or a constitutional mal-inferiority.

Pitzen (Munich) dealt with the treatment of coxa vara based on the experiences of 177 of his own cases in the Munich clinic. Until the age of five years, it is found that extension and counterextension, with abduction and inward rotation, are successful. With epiphyseolysis the extension should be discontinued because of the danger of pseudarthrosis. In coxa vara of adolescents, the redressment of the slipped epiphysis may be indicated while there still exists a marked epiphyseal line. The result of the reposition can be demonstrated only by stereoscopic roentgenograms in both the ventrodorsal and Lauenstein's positions. The reposed top of the caput may consolidate, but often the structure of the bone is destroyed. The viability of the epiphysis depends on its nutrition. It is therefore advantageous to wear a protective apparatus for a long time until the x-ray shows sufficient deposition of calcium in the head. In case the reposition fails, osteotomy is indicated, with the object of lifting the neck of the femur to improve the function of the glutei. In severe functional muscular disturbance, with marked deformity, the question of operative mobilization is to be taken into consideration in the severe unilateral cases to produce an arthrodesis of the joint. In serious loss of function of the muscles, muscle transplantation after redressment is performed in order to prevent relapse into the incorrect position. In youths the other hip sometimes becomes affected while the first is under treatment. For this reason, both sides should always be controlled by the x-ray.

Hass (Vienna) reported the experiences in the Lorenz Clinic, and pointed out the favorable results of the reposition in cases of coxa vara adolescentium after epiphyseolysis. Good results may be expected only in early cases (within the first four weeks). In older cases inversion, with the aim to correct the adduction contracture, is the only method to be considered.

Scherb (Zurich) has found by means of timely fixed ischiometric investigations of infantile hip joints some kind of interference between the existing structure of the trabeculae and their functional demands, the result of it being a weakening of the structure, which in vain endeavors to adapt itself. Thus may be explained the periods of pain and the changing of the inclination-angle of the collum femoris. In the discussion the communication of Brandes (Dortmund) was remarkable. Since 1922 he has treated such cases by removing the trochanter major, under conviction that the traction of the pelvotrochanteric muscles due to this weakness of the neck of the femur produces a coxa vara posture. He demonstrated by some x-ray pictures the slowly ensuing spontaneous erection.

Lindemann (Kiel) has never observed a complete restoration of the curved collum femoris due to reposition. The plaster redressment renders most cases painless.

Riedel (Frankfort a.M.) recommends the subtrochanteric osteotomy with Schanz' screws; Mommsen (Berlin), the hinge osteotomy for the most severe cases.

END RESULTS OF THE TREATMENT OF CONGENITAL LUXATION OF THE HIP JOINT

Max Lange (Munich) presented the introductory collective report and discussed the numerous phases of the problem of early and late reluxations and their causes, as

well as the late symptoms, which have not been well known until recently; also, particularly, the deformities of the reduced head of the femur. Without doubt the trauma of the reposition favorably influences the later transformation of the head. The movement of reduction by mechanical appliances is less traumatizing than the manual, which latter is often very violent. There are four requirements which should be considered: (1) The early reduction (Gaugele, Gocht); (2) The restraining therapy; (3) The firm fixation of the head under the Y cartilage (contrary to the former conception of concentric fixation); (4) The gradual changing of the position of the head after removal of the plaster. In examination of the end results of cases treated in 1914, twenty-two per cent. proved to be ideal, anatomically and clinically; thirty-three per cent. unilateral and thirty-one per cent. bilateral cases were only functionally good. The cases treated between 1915 and 1925 showed seventy-five per cent. functionally good results in the early reduced cases. Therefore, in the average, nearly one-half of the patients could be considered as cured.

Spitzy (Vienna) reported a series of good results of the plastic operation on the cotyloid cavity. A graft of the tibia is implanted tile-like just above the acetabulum after the reduction, and this forms in the course of years an excellent roof and furnishes good apposition for the head.

Deutschländer (Hamburg) dealt with the obstacles of reposition and retention in open reduction. Among the difficulties found are the shallow primary acetabulum, irregular forms of the reduced head and rudimentary neck of the femur, as well as distortion and curvatures of the latter. There are also found infoldings of the soft parts, total or partial interpositions of the capsule, hypertrophied ligamentum teres, and atrophic condition of the muscles and the fascia.

Natzler (Mühlheim), at the postmorten examination of a thirteen-months-old child, in which case the hips had been reduced, found on both heads an osteo-arthritis deformans with necrosis, probably due to the trauma of reposition.

In the discussion, Krukenberg decidedly refuted the theory of Calot, which claims that the trophic disturbances of the juvenile head of the femur, as described by Calvé, Legg, and Perthes, are to be explained by a congenital subluxation. Calot's double acetabulum is nothing more than the fossa acetabuli; his interpretation is based on an anatomical error.

Hass (Vienna) emphasized the necessity of extending the statistical observations over a greater space of time,—at least through the period of growth,—since apparently well reduced hips are liable to become troublesome at puberty. He directed attention to some improvements in the treatment of reposition and retention (careful manual manoeuvers in reposition, fixation, and retention in an accentuated primary position). The plaster dressing remains from three to nine months, changed once during this period.

During the third day of the meeting a number of remarkable individual reports were presented:

Gaugele (Zwickau) gave results of tests in the treatment of postural exercises of tuberculous joints, after Rollier (Bier). He is of the opinion that cessation of the discharge alone is not sufficient proof of complete healing, and held to his former proposition to carry on under greatest caution the passive movements with the cured extended joints.

Kuh (Prague) reported good effects of Doppler's operation upon a man of sixty-three, with intensive arteriosclerosis and prominent symptoms in the legs. One is generally advised to perform the Leriche operation on the walls of blood vessels.

In a film of Böhler (Vienna) was shown his extraordinary, skillful technique of treatment of fractures with traction and countertraction, in a severe compression fracture of the os calcis.

Böhm (Berlin) has continued his researches upon the development of the forms of the foot, and showed the development of their architecture, with description of the embryologic development of the pes valgus staticus.

Debrunner (Zurich) succeeded in intra-uterine strangulation experiments by operation, with the object of clarifying the etiology of congenital deformities. He succeeded in the experimental production of amniotic strangulation with consequent mutilations of the extremities. In the foetal skeleton the healing of the fracture occurs quickly.

Brandes simplified the technique of the hallux valgus operation by removing two-thirds of the basal phalanx of the great toe (Robert Jones). Only the exostosis is removed. On the tenth day the patients are able to get up.

The afternoons of the first two days were filled with interesting demonstrations of silk-tendon work at the Lange clinic and by a lecture of v. Baeyer, who now applies to mechanical conditions of the arm his interesting investigations upon the disturbed movements of the leg.

The next meeting, which will be the Jubilee Congress on the occasion of the twenty-fifth anniversary of the foundation of the German Orthopaedic Society, will be held with the chairman, v. Baeyer, in September 1930, at Heidelberg.

Czecho-Slovakian Orthopaedic Society

The fifth meeting of the Czecho-Slovakian Orthopaedic Society, held September 28 and 29, 1929, at the Charles University in Prague, was opened by the Director of the Clinic, Professor Tobiášek, of Prague, and the following guests were welcomed by Professor Špišič, of Zagreb: Dr. Sorrel and Dr. Galland, of Berck-Plage; Dr. Ducroquet, of Paris; Dr. Lagrot and Dr. Laveruhe, of Algiers; Dr. Minář, Dr. Grospić, and Dr. Velebič, of Yugoslavia. There were also present delegates from all parts of Czecho-Slovakia. Professor Chlumský, of Bratislava, was ill, and for the first time unable to attend the Congress.

The subjects discussed at this Congress were: The Place and Methods of Amputation; The Diseases of the Amputation Stumps; The Construction of the Prostheses.

Docent Dr. Zahradnický, of Prague, stated that methods of amputation are today fully standardized, but often are not adequately followed. Frequently younger surgeons are not sufficiently familiar with these various methods as seen by the results in various hospitals. Zahradnický, in his experience, has failed to see a sufficiently large number of good amputation stumps, and believes that it is necessary to have the cooperation of the general surgeon, the orthopaedic surgeon, and the mechanic. It is always preferable to sacrifice a few centimeters of the length of the bone in order to have a good stump, well covered with soft parts. He emphasized the importance of considering the possibility of using the grasping and moving powers of the stump, and expresses his opinion that in the future it should be possible to utilize cinematization, the idea of which is good, but up to the present time the results have not been satisfactory.

Docent Dr. Bárta, of Prague, recommended the Gritti amputation.

Dr. Sorrel, of Berck-Plage, described the disarticulation of the hip joint, always a serious operation, in which every moment must be preserved. He operates under lumbar anaesthesia, performs a ligature of the femoral vessels, and then uses the transfixion method. He has had excellent results, using the prostheses which have been constructed by Ducroquet. The Syme amputation is excellent, associated with the elongation of the tendo Achillis. The prosthesis of Ducroquet for this amputation is also so excellent that frequently in walking the limp is not noticeable.

Prof. Špišič, of Zagreb, spoke of the diseases of the amputation stump and their treatment. He emphasized the need of performing the amputation with the future function of the stump and the prosthesis to be used in mind. The stump must bear the whole weight of the body, and be able to replace the limb with the prosthesis. The obstacles to good function of the stumps are contractions, scars, ulcers, exostoses, and neurons. He showed by illustrations the result of cinematization of the stumps of the upper extremities on which he had operated, but considers that the value of cinematization is today still problematical. It must be taken into consideration that it is possible to make from a very good stump a pathological one.

Docent Dr. Burian, of Prague, stated that the aim of plastic surgery is the treatment of the amelioration of the amputation stumps. The autoplastic treatment of stumps has definite indications when there are scars and ulcers which it is necessary to avoid, and if necessary to shorten the stump, provided the bone is intact. In deciding between reamputation and autoplasty, the social position and the psychic state of the patient must be taken into consideration. The reamputation is more of a shock; plastic surgery consumes more time.

Docent Dr. Schulz, of Prague, discussed the difficulties of amputation in children in whom the bones are in the process of growth, and emphasized the special need of care with these cases.

Prof. Tobiášek emphasized that the best results are obtained when both the operation for the amputation and the care for the prosthesis are in the same hands; emphasized the danger of separating these two parts of the treatment. He considers that cinematization has a future but still needs development in order to obtain the best results.

Dr. Polívka, of Prague, does not favor the Gritti amputation; Docent Bárta is satisfied with its results.

Dr. Minář, of Lublaň, considers that the best prosthesis for the lower extremity is one constructed of wood and he demonstrates very excellent pictures of its manufacture as it is made in Putti's Clinic in Bologna.

Docent Frejka, of Brno, discussed the problem of prostheses of the upper extremity. He stated that in contrast to those of the lower extremity, they are not yet satisfactory. Most patients content themselves with so called "dress arms"; a few use the worker's arm; the mechanical prostheses are very rarely used. He stated that cinematization stumps he has not yet seen in his country. The prosthesis should not be considered a substitute for the sensitive power of the hand, and therefore the greatest care must be taken to use the amputation stump itself for work. He has used the Kruckenberg operation in six of his cases with perfect results (100 per cent.). He stated that in the future it will be necessary to develop better prostheses for the upper extremity, for we cannot content ourselves with purely ornamental arms and hands, but must substitute for them mechanical prostheses which keep not only the form but also the natural movements of the upper extremity. It is a question which of these prostheses is the better,—the one which utilizes the movements of the stump, or the one with cinematization,—and this cannot be answered definitely today. Opposed to the good results which are reported by Sauerbruch, who has performed cinematization in about 2000 cases, other operators still maintain that the utilizing of the natural movements of the stump is the more simple and the better method.

Professor Koch, of Bratislava, discussed the site of amputation, stating that it must be chosen according to the disease. The construction of the prosthesis is purely a mechanical problem, and it must be taken as a principle that the prosthesis is to be constructed according to the stump, and the amputation not made with reference to the fitting or the requirements of the prosthesis.

Dr. Sorrel read the paper of Dr. Mathieu, of Paris, on "Extra-articular Arthrodesis of the Hip Joint". For osteoplastic material he uses a bone from the greater trochanter and the ilium. He gave statistics of eighteen cases, in seventeen of which the result was good, with one death from miliary tuberculosis. He operates only in cases of tuberculosis of the hip joint in which the tuberculosis can be considered as healed, and in which pseudarthrosis is the cause of continued pain.

Dr. Ducroquet, of Paris, demonstrated the results of the method of Ducroquet, Senior, which is plaster-of-Paris *"à chambre libre"* (See review in Current Literature section of this *Journal*), in the treatment of knock-knee, bow-leg, and congenital dislocation of the hip.

Dr. Galland, of Berck-Plage, described the mechanism of the evolution of the deformity in tuberculous spondylitis of the lumbar and dorsal spine, and stated that fixation by bone graft he uses only in adults and in the stage of repair, employing the short

bone graft, connecting only the vertebrae attacked by the disease. He stated that it is possible to demonstrate experimentally that only a short bone graft is required.

Papers were also presented by Dr. Lagrot, of Algiers, on "The Verneuil-Kümmel Disease"; by Docent Dr. Burian, of Prague, on the results of epithelial inlay in plastic operations of the face.

Dr. Ducroquet presented the operating table of Ducroquet, Senior; Dr. Galland, the latest model of the operating table constructed especially for orthopaedic surgery.

Docent Zahradnický demonstrated his treatment of congenital dislocation of the hip.

Dr. Galland spoke of Calvé's method of puncture of cold abscess in tuberculous spondylitis.

Professor Levit, of Prague, demonstrated a case in which the patella was removed forty years ago. The present function is normal.

Dr. Neufeld, of Bratislava, demonstrated a case of conservative reposition of osteomyelitic luxation of the hip; also a case of congenital luxation of the radius. These two cases were from the clinic of Prof. Chlumský.

Dr. Jaroš, of Prague, showed a case of bilateral Freiberg-Köhler disease.

Dr. Havránek, of Luže-Košumberk, demonstrated three cases of Osgood-Schlatter disease.

Dr. Vavrda, of Bratislava, presented results of experiments on rabbits and dogs in producing a scoliosis. Eight animals were operated upon. Scoliosis resulted in only two, in which there was a resection of two or three transverse processes.

The following officers were elected for the coming year:

Docent Dr. Schulz, President.
Professor Tobiášek, Professor Kostlivý, Dr. Nebeský } Vice-presidents.
Dr. Havránek, Treasurer.
Docent Dr. Frejka, Dr. Račanský, Honorary Secretaries, and eight members of the Committee.

It was decided that the subject for discussion of the next Congress would be deformity of the foot, particularly the deformities which are produced by the improper footwear. The Congress will be held in June 1930, at Zlín.

The following Honorary Members were unanimously elected:

Dr. E. G. Brackett, Boston, Mass.
Dr. Etienne Sorrel, Berck-Plage.
Dr. Marcel Galland, Berck-Plage.
Dr. Paul Mathieu, Paris.
Dr. Robert Ducroquet, Paris.
Dr. Algot, Algiers.
Professor Dr. V. Chlumský, Bratislava.
Professor Dr. B. Špišič, Zagreb.

ITALIAN ORTHOPAEDIC SOCIETY

The Twentieth Congress of the Italian Orthopaedic Society was held in Genoa on October 22 and 23, 1929. It was opened by the President, Prof. Ottorino Uffreduzzi.

Prof. Dario Maragliano and Prof. Adriano Muggia presented the subject of "Endocrine Alterations and Deformities". They stated that the present findings indicate that almost all the endocrine glands exercise an influence on the growth and formation of the locomotor apparatus; that this influence has a characteristic manifestation for each gland or group of glands. For instance, the thyroid influences particularly the processes of growth and the differentiation of cartilage and its ossification, but has little effect on the processes of periosteal and bone ossification; the parathyroid gland, on the other hand, regulates the changes in the calcium content of the skeleton, and plays a part in the maintenance of the integrity of the osseous structures. The thymus gland is supposed to

influence certain of the elastic and fibrous tissues of the capsular ligaments in various ages, preponderance of the elastic tissues during prepuberty, regression of the elastic tissues and preponderance of the fibrous tissue during and after puberty in the male.

It was pointed out by Prof. Pende, in regard to endocrine functions, that the reaction of Abderhalden and the enzyme reaction of Sivori and Rebaudi (which in other cases have been found useful) did not have real diagnostic value in endocrinology. The numerous methods of deduction which are based on specific reactions for each case are not of value clinically, with the exception of Trendelenburg's method. Thus the definite pharmacodynamic proofs which have had some considerable attention for the past fifteen years are considered today as only accessories and not essentials.

Prof. Dario Maragliano also stated that it is better to speak of the relation between endocrine alterations and dystrophies of the locomotor apparatus than the difference between endocrine alterations and deformities. He mentions the fact that orthopaedic surgery no longer limits itself to the correction of deformities already established, but embraces a much larger field, and called attention to the fact that the close relationship between these congenital and acquired affections of the locomotor apparatus and traumatology is now established and they are studied together, with the aid of roentgenology and pathological anatomy. Today, with this increasing collaboration, the orthopaedic surgeon is seeking the aid of the endocrinologist in order to establish the effect of the various endocrine glands in their relation to osteopathic, arthropathic, myopathic, and fibro-elastopathic conditions which may lead to deformity. In consideration of the undeniable coincidence of the various disturbances of the locomotor apparatus with the diverse endocrine alterations, it is a question whether this is a pure coincidence or whether endocrine pathology is a causative factor, or at least the etiologic coefficient. From this point of view, the author offered the following temporary classifications: (1) a diseased condition of the locomotor apparatus which results from direct injuries without the involvement of the hormones; final alterations are to be considered as a mere coincidence and not as a constant finding; (2) diseased conditions of the locomotor apparatus which are the result of endocrine alterations sufficiently severe to develop multiple lesions on a normal locomotor apparatus; (3) diseased conditions of the locomotor apparatus due to a combined constitutional and acquired predisposition and to endocrine alterations; (4) diseased conditions of the locomotor apparatus due to the action of moderate or minimum endocrine disturbances on apparatus susceptible by constitutional and acquired pathological conditions (In this group could be placed the circumscribed alterations of the locomotor apparatus, from endocrine disturbances which would not of themselves influence normal apparatus but which do affect more highly sensitized apparatus).

The observations made serve more or less to explain and to establish the possibility that for some dystrophies and deformities of the locomotor apparatus, endocrine alterations play a part,—sometimes as preponderant causal factors, more often as pathological coefficients. If this possibility is admitted from a theoretical point of view, it is necessary to take into consideration the fact that it is very rare clinically.

Dr. Giuseppe Annovazzi, of Milan, presented a paper on "Orthopaedic Deformities of Adolescence—Constitutional Morphology". The author has examined eighty cases of various types of deformities of adolescence, and concludes: (1) That in individuals who at the age of thirteen, fourteen, fifteen present exaggerated body development (longitudinally, not transversely), with vigor equal or superior to the average adult, there exists a relation between the morphological constitution and deformity of the trunk not due to skeletal malformations. Signs of hypertrophy, associated with hypogenitalism, are evident in some of these cases. (2) It would appear that in contradiction to the known facts, there exists no association between the morphologic constitution and the deformities of valgus in the knees of adolescents. These deformities, if not due to skeletal alterations, must be considered to bear a relation to muscular hyperdevelopment associated with insufficient ligamentous tissue, which is a result of peculiar general conditions of the individual. In some cases the hypothesis can be advanced

that the deformity is due to partial hypophyseal insufficiency. (3) Muscular weakness and an insufficiency of ligamentous tissue play a preponderant rôle in individuals with flat feet, and morphological constitution must also be considered and its claim that flat-foot is characteristic of the macrosplanchnic individual. (4) The growth of the deformity in the adolescent takes place in the prepuberal period and in the period immediately following puberty, during which there is most rapid growth in the length of the skeleton, and when there is no equilibrium between the muscular strength and the length of the long bones.

Dr. Mario Camurati, of Bologna: "Epiphyseal Destruction of the Hip Bone and the Syndrome of Froelich". At the Istituto Rizzoli, in fourteen cases of pure dislocation of the proximal epiphysis of the femur, six (42.85 per cent.) presented a picture of adiposogenital dystrophia. Dr. Camurati emphasizes the importance of the clinical x-ray syndesmology, and showed x-rays and photographs of many cases illustrating the coincidence between articular syndesmology and morphology in relation to the pathogenic conditions.

Prof. Raffaele Zanoli, of Bologna: "Renal Pseudorickets". Prof. Zanoli presented thirty-four clinical observations relative to the syndrome, distinguished on the one side from renal lesions (chronic renal nephritis), and on the other from the osseous deformities of late body growth; the syndrome is sometimes called renal dwarfism. The renal lesion is in most cases associated with a chronic interstitial nephritis and only in four cases was due to calculi. The autopsy on sixteen of these cases disclosed an atrophied and sclerosed form of kidney. Skeletal deformities are frequent; in thirty-four, twenty-three showed osseous deformity (67 per cent.). The period of appearance of this condition is variable—usually between four and five years of age, but not infrequently as late as twelve or fifteen. The most frequent deformity is seen in the knees and is often bilateral, but other deformities appear,—such as scoliosis, multiple epiphyseal enlargement, coxa vara, costal rosary, and deformed chest.

The extreme grades of the retrogression vary between two and nine years of age, with an average of three or four years. This retarded growth in severe cases amounts to an actual dwarfism, as observed in a series of cases between thirteen and nineteen years of age, and is characterized also by a sexual undevelopment and absence of special sex characteristics. Dwarfism and childhood are in direct proportion to the period of this appearance of the renal lesion. Pathogenetically Dr. Zanoli upholds the accepted hypothesis of a renal lesion, usually congenital, with a repercussion on the skeletal system and the sexual organs. Knowledge of this syndrome is of a practical importance, because of the occasional occurrence of death in osteotomy and in simple osteoclasis.

Prof. Demetrio Bargellini, of Torino: "Coxa Vara Adolescentium". Dr. Bargellini cites two cases of bilateral coxa vara seen before puberty, one of which was observed for a period of six years and which has now developed into a definite form; and the second case, under observation for six months, was closely followed during a period of successful treatment by forced straightening. The x-rays in the two cases show individual alterations which are accentuated by the load on the affected part, and examination of the constitutional conditions designated both cases as of the constitutional type. Dealing with the individual case Dr. Bargellini insists that in such cases the genesis and the therapy must not be purely mechanical, but the evolution and development of each individual should be borne in mind.

Dr. Francesco Cabras, of Venice: "Spontaneous Destruction of the Hip Bone and Endocrine Disturbances". Dr. Cabras presented x-rays of three cases of epiphyseal destruction of the hip, one developing spontaneously and two following slight injury. He was unable to attribute the cause of the softening of the epiphyseal cartilage to tuberculous or syphilitic lesions, rickets, or to other acute intercurrent disease. Dr. Cabras considers it necessary to investigate for some form of endocrine disturbance all cases which present these characteristics.

Dr. Andrea Albanese, of Milan: "The Hypophysis in the Pathogenesis of Juvenile Dorsal Kyphosis". From an analytical study of thirty cases in the Orthopaedic Clinic

of Milan, Dr. Albanese concludes that the hypophysis which shows any alteration in its morphoregulatory and trophoregulatory functions of the skeleton produces in the period of development a condition which often is shown in a juvenile dorsal kyphosis.

Dr. Evandro Pasquali, of Bologna: "Angiomatous and Skeletal Deformities in the Endocrine Subject". Dr. Pasquali cites a severe case of kyphoscoliosis asymmetry of the pelvis, and a lymphoangiofibroma verruca mollusca localized in the abdomen, in the buttocks, and the left leg. He demonstrated photographs and x-rays taken of the patient at the age of sixteen and the age of twenty-two, showing the alteration in the conditions in this period of time. From the history and examination of the patient it was seen that the skeletal conditions influenced during the period of development were due to a dystrophy resulting from an endocrine disturbance with possibly congenital tumor manifestation.

Prof. Edoardo Calandra, of Palermo: "Irradiations of the Thymus, and Skeletal Alterations". Dr. Calandra gave the results of experiments on dogs which were treated by "endotimina". Groups of dogs were used, three of the same litter in each group; one as a control, one treated by injections of "endotimina", and the other irradiated. Animals treated by injections of the "endotimina" appeared larger than the controls, the thymus was large and showed a noticeable increase in the number of lymphoid cells in the cortex. Skeletal segments appeared better developed in length and thickness in comparison with the controls. The zone showing growth of cartilage was large, with rich vascularization and a deficient ossification.

The irradiated animals appeared smaller than the controls, the thymus of reduced dimensions, with almost total disappearance of the lymphoid cortical cells and enlargement of Hassal's corpuscles. There was smaller length and thickness of the skeletal segments, with increase of the fragility of the long bones. In the cartilage the growth of the seriated zone was somewhat smaller and in the osseous tissue there were large medullary spaces; osseous trabeculae were rare; there was a rich vascularization; the haversian canals were dilated. The animals died from acidosis some time after the second month of treatment.

Prof. Roberto Alessandri, of Rome: "Drying Osteochondritis of the Knee Pan". Dr. Alessandri described lesions of the patella to which he has recently called attention. There are seen alterations which show a degenerative condition of the fissural type in individuals with arthritic disturbances of a chronic nature, some appearing after trauma and others spontaneously. He described a personal case, and reported that on exploration the covering of the cartilage of the patella had a velvety degenerative appearance, with crossing fissures in all directions and with numerous ecchondroses on the femoral condyles which were successfully removed and later the function of the knee became perfect.

Dr. Antonio Mezzari, of Valdoltra: "Vertebral Osteoplastic Surgery". After long treatment with recumbency and with heliotherapy, and when the maximum correction of the deformity is obtained and the process is in a retrogressive stage, Dr. Mezzari operates for a posterior osteosynthesis with the object of giving added correction and added protection. When there exists a noticeable destruction of the bone, he prefers the Albee operation; when there is good support, he uses the Hibbs' operation in a modified form. He presented forty-eight cases with good results.

Dr. Myriam Ciancio, of Valdoltra: "The Recognized Limits of Resection and of Heliotherapy in the Treatment of Tuberculosis of the Knee in Adults". Dr. Ciancio presented thirty-two cases operated upon, and compared them with 214 cases treated by conservative methods.

Prof. Ugo Camera, of Turin: "The Epiphyseal Detachment of the Superior Extremity of the Femur of Obstetrical Origin". Prof. Camera referred to three cases of this lesion, in general little studied. He insisted upon its frequency, explained the mechanism of its production and the method of treatment. He raised the question as to whether many of the cases of so called congenital coxa vara should not be considered as cases of a progressive epiphyseal detachment which had passed unobserved.

Prof. Silvio Crainz, of Rome: "The Post-traumatic Ossification of the Elbow". Prof. Crainz showed by x-rays the evolutionary process and the involution of these alterations in two cases. He described the circumstances which tend to favor this condition and to hasten recovery.

Dr. Giuseppe Tancredi, of Rome: "Contributions to the Study of the End Results in Arthroplasty". Dr. Tancredi showed six cases studied at a late postoperative period, and showed the morphology of the tissue of the osseous heads in the new articulation and the best results obtained. He calls attention to the very evident contrast between the form and function.

Prof. Luigi De Gaetano, of Naples: "Contribution to the Technique of Arthroplastic Surgery of the Hip". Prof. De Gaetano enumerated the advantages obtained in bone surgery by using the cuneiform and fan-shaped scalpels,—particularly those which present a definite curve on the flat, which he has devised. He illustrated the technique of the arthroplastic surgery of the hip, the most important points being: (1) the establishment of a hem in a U-shaped incision, and the use of the same incision in the layer of the aponeurosis; (2) the use of the De Gaetano scalpel for the detachment of the femoral head from the acetabular cavity; (3) the use of special materials in the fixation of the aponeurotic capsule which is placed over the femoral head. There is difficulty in placing the stitches of the fascia lata in the soft periosteal tissues at the base of the head. After having fixed the stitches posteriorly, the thread of fascia is passed around the base of the head and is then tightened; (4) finally, to maintain the contact the great trochanter is detached in order to replace the muscles. In replacing the trochanter, Dr. Gaetano uses a screw of the Ombrédanne type through a small cutaneous incision. When callus is formed, the screw is removed.

Dr. Salvatore Rollo of Naples: "Chronic Epiphysitis and Metaphysitis from Staphylococcus Infections". Dr. Rollo illustrated four cases in which there were isolated germs of mild virulence and warns against the danger of diagnostic errors, confusing it with tuberculous or syphilitic processes and with osteosarcoma or Brodie's abscess.

Prof. Loranzo Adolfo Gaibissi, of Savona: "Morphologic Modification of the Diaphysis in the Upper Epiphysis of the Femur in Tuberculous Osteosynovitis of the Knee". Prof. Gaibissi gave the results of his studies of twenty cases, in ten of which there was a greater or less lengthening, but in mild cases there was observed a loss of the bone structure in the upper epiphysis and the neck of the femur. In cases of greater severity, those that had been treated by traction, there was seen an aperture more or less pronounced at the angle of inclination. In a small number of the cases the neck showed a rarefaction, with a thickening of the cortex, and presented the appearance seen in the diaphysis.

Prof. Enrico Ettorre, of Milan: "The Inferior Tibiofibula Synostosis". Prof. Ettorre reported the case of a girl of nineteen who showed fibrous osteodystrophy in tibia and fibula, extending through the inferior third of the bone. He concludes that on account of the nature of this local osteodystrophic process, demonstrated by the histological examination, the case must be considered as a congenital condition originating in the early stages of development (precartilage stage). He emphasized the necessity of histological examination in order to determine the correct diagnosis.

Dr. Edmondo Venezian, of Rome: "Spontaneous Recovery of the Congenital Luxation of the Hip". Dr. Venezian showed a case in which at the age of sixteen months x-ray and clinical examination disclosed a bilateral luxation of the supracondyloid type. At the age of five years, when the treatment was begun, there was found on one side, both by clinical examination and by x-ray, a normal hip. He discussed the etiologic factors of this condition which might be taken into account.

The following papers were also presented:

Dr. Elbano Adriani, of Venice: "The Syringo-myelic Arthopathies".

Dr. Pier Filippo Busatti, of Florence: "Statistical Observations on Articular Fractures".

Dr. Leopoldo Giuntini of Florence: "Coxofemoral Dystrophies of Traumatic Origin".

Dr. Rosario Marziani, of Milan: "Osteoblastocytoma".

Prof. Gherardo Forni, of Bologna: "Diaphysary Resection of the Sarcoma of the Bone Marrow and its Constitution, Taken by Autoplastic Transplant from the Tibia".

Dr. Pietro Valdoni, of Rome: "Contribution to Proliferating Hyperplastic-tendosynovitic Etiology".

Prof. Angelo Lavermicocca, of Turin: "A Study of the Re-education in Walking".

Prof. Antonio Poli, of Milan: "The Principal Methods of Tendon Fixation on the Skeleton".

Prof. Ulisse Vignolo and Dr. Starico Costa, of Genoa: "Surgical Remineralizations in Tuberculous Osteo-arthritis".

Dr. Luigi Bay, of Turin: "Iodin and the Thyroids in Relation to Some Deformities of Rickets".

Prof. Andrea Bertocchi, of Turin: "Osteoplastic Amputations of Fixed Bone".

Prof. Vittorio Ferrero, of Turin: "Traumatic Lesions of the Fibrocartilage Structures of the Knee".

Prof. M. Agrifoglio, of Genoa: "Contributions to the Study of Carpometacarpal Luxation".

Prof. Francesco Delitala, of Venice: "Cases of Bloodless Readjustments of the Knee".

Dr. Gioffredo Giraudi, of Milan: "Cartilage Nodules of Schmorl".

Current Literature

LEHRBUCH DER ORTHOPÄDIE (Textbook of Orthopaedic Surgery). Edited by Geheimrat Prof. Fritz Lange with the collaboration of Dr. Bade, Dr. Ritter von Baeyer, Prof. Dr. Beck, Prof. Dr. Biesalski, Prof. Dr. Bruhn, Dr. Gaugele, Prof. Dr. Hohmann, Geh. Hofrat Prof. Dr. Lange, Prof. Dr. Ludloff, Prof. Dr. Schede, and Prof. Dr. Spitzy. Ed. 3. Jena, Gustav Fischer, 1928.

This textbook strives more than any other known to the reviewer to cover the entire field of Orthopaedic Surgery. It must impress every one who reads its 700 pages, first with the magnitude of the modern orthopaedic specialty, second with the thoroughness, so characteristically German, which marks the general arrangement of the material and the development of each topic. The authors, eleven in number, including some of the most eminent figures in the German orthopaedic world, have tried, under Lange's tactful direction, to smooth out individual differences so as to present a unified system. When this has been impossible, as for instance in the treatment of tuberculosis, the divergences are frankly admitted and the conservative as well as the radical measures are described.

In the introduction, Lange stresses the importance of orthopaedic surgery as an independent specialty and also its value to the general practitioner. "Every doctor", he states, "must in the interest of the physical well being of his community have a measure of orthopaedic training." This is necessary not merely to prevent and correct crippledom, but to aid in making the cripple productive and self-supporting. This sociological aspect of orthopaedic surgery is best exemplified in Biesalski's definition: "Orthopaedic surgery is the study and treatment of disturbances of the organs of locomotion with due regard for the sociological as well as the biological indications (*Orthopädie ist die Erforschung und Behandlung der krankhaften Zustände des Bewegungsapparates unter sozial-biologischer Indikation*)". It is from this broad point of view that Lange's textbook has been written; it includes, therefore, sections on the care of cripples (*Krüppelfursorge*), artificial limbs, and vocational therapy, as well as the conventional chapters on orthopaedic diagnosis and treatment.

Although it would be invidious to try to decide which of the contributors has accomplished his task with most distinction, the reviewer must acknowledge his particular indebtedness to Geheimrat Lange for his lucid enunciation of the general principles of orthopaedic diagnosis and treatment, to Prof. Biesalski for his brilliant chapter on neurological diseases, and to Prof. Spitzy for his enlivening discussion of scoliosis.

In general, as regards the presentation of pathology, symptomatology, and diagnosis, the book is on a much higher plane than most textbooks. The discussion of treatment, however, impresses me with the urgent need for a freer interchange of thought between our German colleagues and ourselves. Science should be international, yet it is quite evident, after reading this volume, that a broad gulf separates the German therapeutic school from the American. Bone-graft surgery is barely mentioned, the Hoke and Campbell operations are apparently unknown, fusion methods in the treatment of tuberculosis are not even considered, much less recommended, and open operation for congenital dislocation of the hip is set aside with the statement: "The open operation is the precursor of the bloodless reduction and paved the way for it; today, however, it is relegated completely to the background".

It is to be hoped that when the next edition of this noted "*Lehrbuch*" goes to print, this gulf between American and German thought will have been bridged, and that this textbook will truly represent international orthopaedic experience.—*Leo Mayer, M.D., New York, N.Y.*

OSTEOMYELITIS AND COMPOUND FRACTURES AND OTHER INFECTED WOUNDS. Treatment by the Method of Drainage and Rest. By H. Winnett Orr, M.D., F.A.C.S. St. Louis, The C. V. Mosby Company, 1929, $5.00.

In publishing his earlier booklet, Orr did a distinct service, as has been said before in these columns,—a service of real value in waking us up.

Many of us had known enough years ago to get away from gauze, so called drains; some had not. Some of us have been using grease dressings for years.

What he has done is to advertise the vaselin treatment of open wounds,—a very effective dressing which fills the wound, leaving no dead spaces for bacterial culture pools, protects the wound from outside contamination, from chilling, and—important—from air drying, while it does not appreciably block drainage.

This is so far in advance of what is done to most wounds by most doctors that one must be ready to help advocate it rather strongly.

It was, I think, ancient Guy de Chauliac who said, "Be not too curious in the dressing of wounds".

This Dr. Orr has said again.

As to the treatment of osteomyelitis, traumatic or spontaneous, one does not find anything here that has not been known to interested and informed general surgeons for a good many years.

For instance, the doctrine of very early adequate bone drainage was not quite new even when Murphy wrote the article in 1912, to which Dr. Orr refers.

Nor is there anything in the case reports that is startling. We all get neglected cases and clean them up.

TREATMENT BY MANIPULATION. By A. G. Timbrell Fisher, M. C. New York, The Macmillan Company, 1929, $3.50.

The author states in his preface to the second edition, "Further experience has strengthened the author's conviction, expressed in the first edition, that manipulation when properly performed in suitable cases is a method of treatment of extraordinary value". On reading the book one is carried away by the admirable presentation of the subject, and is compelled to agree with him. The second edition has been revised, additional case histories have been given, and many sections have been rewritten, particularly those dealing with Osteopathy, Tennis Elbow, Chronic Arthritis, and Lesions of the Sacro-iliac Joint.

In Chapter I, Some Observations upon Treatment by Manipulation, the author traces the historical steps by which the tradition of prolonged rest following injury arose, and points out the fallacy of immobilization in the treatment of disabling conditions caused by adhesions. He pleads for a greater emphasis on manipulative treatment in the curricula of our medical schools, and for a more tolerant attitude on the part of members of the medical profession in their outlook toward manipulative methods. There is a description of the types of cases that can be cured by manipulation, with their pathology, diagnosis, and treatment. The author presents general principles in the diagnosis and treatment, pointing out the contraindications and potential dangers of manipulation. In the second edition he has added a section, Manipulation in Chronic Arthritis. With great care in the proper selection of cases careful manipulation may restore complete and painless motion, as adhesions or scar tissue is the cause of the limitation of movement.

Following a discussion of general principles of the prevention, formation, and treatment of adhesions, the succeeding chapters present in detail the special applications, with technical methods and illustrative cases, as applied to the joints of the extremities and spine. The text is amply illustrated by good photographs. There has been an addition of a number of new paragraphs and illustrative cases.

The chapter on Manipulation of the Spine has been entirely rewritten. This chapter was read eagerly with the hope that the author in this second edition would be able to present the indications and contraindications of manipulation in as clear and con-

vincing a way as he presents these as applied to the joints of the extremities. He is not so certain as to the pathological changes in so called sacro-iliac strain, but is inclined to believe in subluxations in the majority of cases, although he states that it is possible that adhesions are the cause. One is left pretty well in the dark as before.

This most interesting and readable book of 192 pages, with its forcible, clear, and concise discussions, fills a much needed place in our medical literature. It most ably presents a subject which has been neglected, and coming from such a man as Fisher is of great value. It deserves to be well studied by physician and surgeon alike, and is of particular value to those interested in the treatment of acute and chronic disabilities of joints.

ORTHOPEDIC SURGERY. Ed. 2. By Sir Robert Jones, Bart, K.B.E., C.B., Ch.M., F.R.C.S., F.A.C.S., and Robert W. Lovett, M.D., F.A.C.S. New York, William Wood and Company, 1929, $11.00.

The second revised edition of "Orthopedic Surgery", by Jones and Lovett, will receive its merited welcome. The constantly increasing communication, with the interchange and assimilation of knowledge and methods in the medical circles in the countries all over the world, lends a supplementary value to a work such as this which has an international character, in addition to that given by the eminent position and large experience of the two authors.

In the preface, Sir Robert pays tribute to his associate in this book, Dr. Lovett, who has died since the first edition was published. Sir Robert has had the assistance of Dr. Nathaniel Allison and Dr. Frank R. Ober, of Boston, Mass., and Mr. Harry Platt, of Manchester, England, in this revision and the preparation for its publication, and this group has brought to this volume a varied experience, in presenting the advance which has taken place in Orthopaedic Surgery since the appearance of the first edition.

The book is comprehensive, comprising over 800 pages, and is profusely illustrated, many new illustrations having been added. Several of the important subjects now occupying the attention of the orthopaedic world have had special attention, and recent knowledge and newer methods of treatment have been incorporated. These particularly are the portions dealing with: Stiffness of Joints, Operative Treatment of Arthritis Deformans, Development of the Affections of Bones, Affections of Adult Bones, Anterior Poliomyelitis, Lateral Curvature of the Spine.

Although the subject of fractures can be but briefly treated in a work of this kind, the reader will be interested in the enlargement of this subject, particularly since the treatment of fractures is now so frequently coming under the care of the orthopaedic surgeon. The balance between the operative and conservative methods of treatment in many of the types of fractures in which there is the greater difficulty in making the decision is well kept, and is of aid to many surgeons in planning the treatment.

New sections have been added on the subjects of tendons, muscles and fasciae, peripheral nerve lesions, progressive affections of bone, vascular lesions of the extremities, amputation and artificial limbs. The authors are following a trend of the present of including under the term Orthopaedic Surgery an increasing number of the affections of the extremities. It is a matter of opinion whether it is the wiser course to group so many of the affections of the extremities under the term Orthopaedic Surgery and to place under one specialty a group of diseases or a group of affections which have no etiological or pathological common denominator, rather than the general tendency at present to consider the field of surgery in a more general sense, and place under the care of a department or group of men those diseases for the understanding of which that department or group of men have particularly fitted themselves.

It is impossible, in a book covering so large a field as is presented in this volume, to enter into the important details of pathology or treatment of the various affections. The clinical examination and diagnosis can be and are more complete, and guidance as to sources for further information of the other details is given to the reader.

The comprehensive character gives an additional value to this book, and furnishes to the reader the latest information by men of wide experience on a very broad group of orthopaedic conditions, and is a definite help to orthopaedic surgeons, as well as to the large number of general surgeons who need information on these subjects.

DIE NAHT UND DAS NAHTMATERIAL IN DER ORTHOPÄDIE (Sutures and Suture Material in Orthopaedics). By Privatdozent Dr. Max Lange, Assistent der orthop. Universitätsklinik in München. Stuttgart, Ferdinand Enke, 1929.

When a great orthopaedic surgeon has emphasized the value of one technical procedure for twenty-five years, no justification of the method should be necessary. But if he is almost the sole exponent of the method, even though it be internationally linked with his name, a monograph in defense of his technique is not unwarranted. Fritz Lange still reports brilliant successes with the use of "silk tendons". Now the young Dozent, Max Lange, has turned to experimental surgery to establish the soundness of his uncle's methods.

The first eleven pages deal with skin sutures. Great care must be used in placing the incision, sewing the skin, and removing the stitches—when "silk tendons" have been buried. We are told even how to hold the forceps in removing dressings. Painstaking animal experimentation has proved just which powder or ointment is most conducive to proper healing.

Almost as an afterthought, there are eleven final pages devoted to the proof of the excellence of Krupp steel wire in the suture of bones. But the excuse for the monograph is the excellent chapter on tendons.

There is an historical summary followed by a series of experiments in tendon surgery with detailed physiologic and histologic studies. Tendon regeneration is analyzed by removing the action of the peritendineum by interposing parchment paper, and then limiting the proliferation of the tendon stumps in the same way in a parallel series. The importance of the tendon sheath is demonstrated, but other experiments show that union of tendons progresses satisfactorily when it has been removed.

A detailed experimental evaluation of the various methods of tendon suture shows the superiority of Lange's technique. With his "*Entspannung*" suture he relieves the tension on the tendon and at the same time approximates the ends.

Careful trial of many substances used in plastic operations on tendons leads to the condemnation of fascia as well as exogenous materials with the exception of silk. Silk is hailed as the optimum. Careful instructions are given for sterilizing it with mercury-oxycyanide, stretching it with a special instrument, and fastening it to muscles or tendons. The various uses for silk tendons are briefly mentioned. Microphotographs of human and animal preparations are shown in proof of the fact that the silk becomes incorporated in the new tendon with a minimum of foreign-body reaction.

Few men will follow all of the experiments, but the illustrations are instructive. Some of the conclusions are interesting because they are contrary to the tenets of American and English surgery. Others will be welcomed as universally accepted facts.

AIDS TO ORTHOPAEDIC SURGERY. By Eric A. Crook, M. Ch., F.R.C.S. New York, William Wood and Company, 1929, $1.50 net.

A pocket-sized book of 232 pages, which deals with the subject of Orthopaedic Surgery. It is evidently intended for the student and the general practitioner, and is comparable to the Orthopaedic Surgery written by D. Augustus Thorndike some years ago.

The text is so limited in each subject that but little latitude is given and much that is valuable is omitted, the whole subject being made to appear much more simple than it really is, but should not lead general surgeons to attempt the treatment of patients, which requires the skill of long training and experience with orthopaedic affections.

INDIVIDUAL GYMNASTICS. By Lillian Curtis Drew. Ed. 4. Philadelphia, Lea & Febiger, 1929.

"Individual Gymnastics" is a handbook of corrective and remedial gymnastics. This is the fourth edition of this work. It has been revised and, with its 127 illustrations, covers very efficiently the field of corrective gymnastics as taught in the recognized schools of Physical Education in this country. Miss Drew is especially fitted to present this phase of gymnastics because of years of experience in teaching it. In dealing with corrective gymnastics as individual gymnastics, the student meets the various problems that present themselves in school and in college work.

The subject of the text is clearly divided into the following headings: individual gymnastics, its place in physical education, conditions for which it is advisable; equipment, the application of individual gymnastics, the teacher's responsibility, its psychology; the human body, pelvic inclination; the upright posture.

There are various types of faulty posture explained and graphically illustrated,—the problem of the school child and the school desk, the parents' responsibility in the matter of home training. Exercises for general and local flexibility of the spine and for body building are tabulated and useful typical programs of exercises follow. The question of scoliosis is discussed and the classification of the different types, as well as the etiology of the same, with instructions for examination of the spine.

Abnormal conditions of the feet, with exercises for the different types of foot trouble, are given in detail and a discussion on the everlasting problem of shoeing, bringing the text to a close with a chapter on overweight and underweight.

For all persons interested in corrective gymnastics, especially for those students of Physical Education who are making a special study of corrective work, "Individual Gymnastics" is recommended.

POSTURE AND HYGIENE OF THE FEET. By Philip Lewin, M.D. New York, Funk & Wagnalls Company, 1929.

It is natural and normal that the public should be interested in health problems, but because of the lack of information, simply put, and within the understanding of the laity, they turn as a source of reference to medical technical books, and frequently unfortunately so. Books that give the necessary information on these important health questions are welcome. Particularly now, with the prevalent destructive footwear, it is needful that the public have the necessary instruction and guidance in regard to preventive measures and general care, including proper shoeing. Many of the preventive and therapeutic measures in reference to the foot can be cared for at home. Dr. Lewin has recognized this important fact, and has given to the public this needful instruction in his book, which appears under the title of "Posture and Hygiene of the Feet". The term "posture" in reference to the foot is well chosen. The subject is treated under the sections of: Foot Hygiene, Proper Care of the Feet, Flat-foot and Its Correction, Disturbances of the Metatarsal Arch, Ankle Sprains and Other Injuries.

It will be found a valuable book both for nursing and household use, and particularly in those schools in which so much attention is now being given to hygiene and general preventive measures in health problems.

The Journal wishes to acknowledge the receipt of the following books sent to the Editorial Department:

Guide to the Surgical Instruments and Objects in the Historical Series with Their History and Development, Museum, Royal College of Surgeons. By C. J. S. Thompson, M.B.E., with a Foreword by the Conservator, Sir Arthur Keith, M.D., F.R.C.S., F.R.S. London, Taylor and Francis, 1929.

Testicular Grafting from Ape to Man. Serge Voronoff and George Alexandrescu; translated by Theodore C. Merrill, M.D. London, Brentano's Ltd.

Über den Wert der wohlgemuthschen Diastasereaktion im Harn als differentialdiagnostisches Hilfsmittel bei akuten Pauchzuständen mit besonderer Berücksichtigung der akuten Pankreasaffektionen. By Torsten Skoog. Acta Chirurgica Scandinavica. Stockholm, Vol. LXV, Supplement 14, 1929.

Über die Behandlung von Brüchen des Oberschenkelschaftes. By Gustav Levander. Acta Chirurgica Scandinavica. Stockholm, Vol. LXV, Supplement 12, 1929.

Svenska Läkaresällskapets Handlingar. Stockholm, Vol. LV, No. 2, 1929.

Die "Tropfenextension". By Prof. S. Tregubow. Reprint from Zeitschrift für orthopädische Chirurgie. Berlin, Vol. LI, 1929.

Die reelle Verlängerung der Extremitäten bei der Knochen- und Gelenktuberkulose. By Prof. S. Tregubow. Reprint from Zeitschrift für orthopädische Chirurgie. Berlin, Vol. LI, 1929.

Ortopedia e Traumatologia dell'Apparato Motore. Napoli, Vol. I, Nos. 2 and 3, July and August 1929.

Giornale Medico dell'Ospedale Civile di Venezia. Venezia, Vol. III, Nos. 4 and 5, August and October 1929.

Bullettino e Atti della Reale Accademia Medica di Roma. Rome, Vol. LV, Nos. 8, 9, and 10, August, September, and October 1929.

Pediatric Bulletin. From Department of Pediatrics, Brownsville and East New York Hospital, Vol. I, No. 1, October 1929.

Anales del Servicio de Traumatología y Cirugía Ortopédica del Hospital Provincial, Ano 1928. Valencia.

Norsk Magasin for Laegevidenskapen. Oslo, XC, No. 12, December 1929.

*Chirurgie des Os et des Articulations des Membres. By P. Lecene, with the collaboration of P. Huet. Paris, Masson et Cie, 1929. 140 fr.

*To be reviewed in a later issue of *The Journal*.

On Muscular Hernia of the Leg. Hugo Ihde. *Acta Chir. Scandinavica*, LXV, 97, 1929.

On the basis of twelve reported cases and a careful review of the literature, muscle hernias are classified as either traumatic or constitutional. The differentiation is of medicolegal importance. The former are to be distinguished from torn muscles by the physical findings. Ruptures of fascia or muscle may heal spontaneously. Where a hernia persists, and gives rise to symptoms, an "orange slice" of the muscle should be removed and the fascia carefully sutured.

Constitutional hernias are found in individuals with other mesodermal weakness as evidenced by postural defects, large inguinal rings, and varicose veins. They arise insidiously and increase in size with physical activity. They require operative correction less frequently than the traumatic type.—*W. P. Blount, M.D., Milwaukee, Wis.*

Proceedings of the Northern Orthopaedic Association at Its Tenth Meeting in Helsingfors, Finland, July 3 and 4, 1928. P. G. K. Bentzon. *Acta Chir. Scandinavica*, LXV, 121, 1929.

The meeting was opened by the chairman, Baron F. Langenskiöld, M.D., Helsingfors.

Poul Guildal, Denmark, discussed the treatment of the "paralytic knee". Isolated quadriceps paralysis is rare. Because of the synergistic action of the hip extensors and to a less extent the gastrocnemius, this paralysis is not very disabling. Isolated involvement of the knee flexors is of still less importance because of the substitution of the action of the hip flexors. In combined paralyses the gluteus maximus is of great value in maintaining the statics of the body, and the gluteus medius in avoiding an awkward gait. The stability of the knee in walking depends also on the stability of the foot and particularly on the strength of the triceps surae. Contractures of the knee itself, and of the foot and hip, are as important as the paralyses. If they develop in spite of prophylactic treatment, they should be corrected by operation. Osteotomy and division of

muscle, tendon, or capsule should be used to improve the statics. Arthrodesis is occasionally justified. Stability of the foot should be assured by tenodesis, or better, bone operation. Function should be improved by muscle transplantation where indicated. Substitution of some of the hamstrings for a paralyzed quadriceps is helpful in permanently relieving knee contractures and in providing for active locking of the knee. All of the hamstrings should not be transplanted if the gastrocnemius is paralyzed because of the danger of developing a recurvatum. Treatment with apparatus is satisfactory when it can be efficiently carried out.

In the discussion, H. Camitz, Sweden, elaborated upon the previous statements and presented a table of the results in seventy-five cases involving disability at the knee. Transplantation of the tensor fascia lata is particularly valuable in relieving flexion and valgus at the knee. Individual indications for the selection of other of the knee flexors depend on the relative power present. To stabilize the foot, astragalectomy is preferable to other bone operations. F. Langenskiöld, Finland, emphasized the functional value of muscle transplantation to replace a paralyzed quadriceps when powerful muscles are available. Osteotomies are of the greatest value in correcting the statics of the knee, but like arthrodeses should not be performed on children. Apparatus is useful to preserve the benefits of operative work for the first year or so. P. Haglund, Sweden, stated that flexion at the knee should be corrected before muscle transplantation is attempted.

Tauno Kalima, Finland, presented a case of polyarthritis which had resulted in ankylosis of the knee at a right angle. An arthroplasty had been done at the age of seventeen, eleven and one-half years previously, according to Payr's technique. While other joints progressed to marked deformity, the right knee had been useful and painless. The excellent result was attributed to the radical excision of the joint capsule.

Gösta Häggqvist read a paper on the development and degeneration of connective tissue, cartilage, and bone. The development of mesodermal structures was traced histologically, and the historical and theoretical considerations elaborated. Collagen, elastin, and lime salts may be inactive for long periods without participating in the metabolism of the body, but they are paraplasmatic structures which are dependent on the physiologic equilibrium of the body. Osteoclasts are not scavengers that attempt the destruction of bone. They are merely visible at the end stage of local bone degeneration, which allows the protoplasm of the bone to become apparent. Connective tissue can develop into cartilage or bone. Professor Häggqvist has never observed the direct transformation of bone into cartilage, but bone may be changed into connective tissue as the result of degenerative processes. P. Haglund emphasized the fact that tissues with primarily a passive function have also their own biological activity which cannot be determined by physics and chemistry. The adaptation to a functional influence is apparent at an early stage, and it is this which is important to orthopaedic surgeons.

Tauno Kalima, Finland, presented a roentgenologic, gross, and microscopic study of a two-months-old, fractured, autoplastic bone transplant. One half had lain free in the medullary cavity as a sequestrum, and was removed at operation. The other portion had become intimately united with the original bone and was left in situ. Microscopically the sequestrum appeared to be necrotic bone invaded by connective tissue and osteoid tissue from the endosteum. Another similar case and a review of the literature were given in support of the importance of the endosteum in the replacement of bone grafts by osteoid tissue.

H. Camitz, Sweden, discussed four cases of bone transplantation in which the periosteum was apparently the important factor in new bone production. Ejner Nyberg, Finland, and P. Guildal, Denmark, added one case each in which grafts had been removed after eighteen months and five years respectively.

Papers which have previously been mentioned in *The Journal* were read by H. Nilsonne and H. Camitz.

H. Nilsonne, Sweden, discussed Friedrich's ataxia from an orthopaedic standpoint. He had collected nine cases. Deformities of the feet appeared early, while spinal curvatures were not observed until after the diagnosis could be easily made. Correction of the deformities is justified because the progress of the disease is slow, and because the resulting improved function is likely to delay the degeneration of the musculature.

The correction of ankylosed, acutely flexed knees by some form of supracondylar osteotomy was recommended and discussed by Haglund, Asplund, Camitz, Bergmann, and Nilsonne.

Bentzon, Denmark, had operated upon three cases of coalitio calcaneo-navicularis. Relief from severe talonavicular osteo-arthritis and flat-foot was obtained by fusing the talonavicular joint and performing an osteotomy at the site of the coalition in two cases. In the third case, in which a painful flat-foot showed no arthritis, a good result was obtained by removing a wedge from the abnormal bone and producing a pseudarthrosis by interposing a flap of fascia. P. Haglund demonstrated a symptomless coalition resulting from an old infectious process. Congenital abnormalities should be differentiated from bone deformities of exogenous origin, he said.

R. Faltin, Finland, discussed his method of detailed marking of roentgenograms with Latin abbreviations. It makes for international legibility and unmistakable orientation. He advocated the use of stereoscopic plates in many fractures.

H. Camitz, Sweden, reported a case of paralysis of the biceps in which he had operated by Steindler's method of transplanting the antibrachial flexors proximally on the humerus. He considered the technique to be superior to the methods of Biesalski and Hohmann. —*W. P. Blount, M.D., Milwaukee, Wis.*

Über die Behandlung der Flexionskontraktur des Kniegelenkes mittels Fascia lata Plastik. (The Correction of Flexion Contracture of the Knee by a Plastic of the Fascia Lata.) H. Camitz. *Acta Chir. Scandinavica*, LXV, 267, 1929.

Various methods are satisfactory for reducing the flexion contractures of the knee which follow polyarthritis or poliomyelitis. The prevention of recurrences is more difficult. Transplantation of the tensor fascia lata to the patella previous to correction of the deformity hastens the process. Its pull then tends to decrease rather than increase the flexion, and maintains the corrected position. A capsulotomy is frequently required as a secondary operation if complete extension is to be obtained.—*W. P. Blount, M.D., Milwaukee, Wis.*

Sacralisation des 5ten Lumbalwirbels. (Sacralization of the Fifth Lumbar Vertebra.) R. Ingebrigtsen. *Acta Chir. Scandinavica*, LXV, 283, 1929.

The examination of 291 pelves and 344 x-rays, and a review of the literature, show that anatomical sacralization of the fifth lumbar vertebra is a normal finding which is present in seventy-five per cent. of all human beings. In this group are included cases of slight variation in the shape of the transverse processes (Le Double's first and second grades). Articulation of the fifth transverse process with the sacrum or ilium constitutes a definite sacralization which may be considered pathological. Such a finding is often linked with the symptom complex of pain in the lumbar region radiating to the sciatic distribution, tenderness over Valleix's point, contractures, and curvatures of the spine. Relief from these symptoms was obtained in the writer's two cases, and in numerous others quoted from the literature, by the resection of the abnormal transverse process. The symptoms are not caused by pressure on the spinal nerves, as evidenced by the infrequency of muscular atrophy. An insufficiency of the lumbar vertebrae results from the asymmetrical bony abnormality. Fatigue and spasm give rise to the radiating neuritic pain. —*W. P. Blount, M.D., Milwaukee, Wis.*

A Peculiar Affection of the Capitulum Humeri, resembling Calvé-Perthes' disease of the Hip. H. J. Panner. *Acta Radiol.*, *X*, 234, 1929.

The author reports three cases of an affection of the capitulum humeri, the origin of which was, in each instance, immediately related to a definite trauma, in boys of ten years or less. The clinical pictures were mild, consisting only of minor functional disturbances. There was undoubtedly complete healing with almost complete return of function, but the course of the disease was lengthy, three years or more. The x-ray pictures were diagnostic. At first, or very soon after the trauma and onset of pain, the pictures showed slight rarefactions of the capitulum humeri, resembling fissures, together with a certain amount of blurring of structural design; later, the osseous center became diminished, and its nucleus much divided. The gradual changes of the capitulum resembled very closely the osseous changes that the head of the femur undergoes in a case of Calvé-Perthes' disease. Eventually the osseous center resumes its normal shape and appearance.

Regarding the treatment of the condition, the author advises merely a certain care in using the arm and guarding against any undue strain.

In concluding, the author states that this condition undoubtedly belongs to the same group as the Calvé-Perthes' disease of the hip, and its true etiology, like that of the latter, is unknown.—*L. J. Miltner, M.D., Iowa City, Iowa.*

Congenital Bone Syphilis. E. P. Pendergrass and R. S. Bromer. *Am. J. of Roentgenol.* XXII, 1, July 1929.

The authors give a histological review of bone formation and development with early x-ray findings. Normal bone has a diaphysis of thick, dense cortex in shape of a cylinder, the center of which is less dense. The epiphyseal line, or better, the diaphyso-epiphyseal line, is one millimeter wide and an unbroken line. It is the zone of temporary calcification, and the limit of advancing ossification. Periosteum of normal bone is not visible.

Congenital syphilis is divided, pathologically, into three stages of severity: Osteochondritis: (1) with increased growth of cartilage cells, temporary calcification increased, ossification decreased; (2) increase of the above points along with a second zone of temporary calcification and a more serrated and irregular diaphyso-epiphyseal line; and (3) abnormal cartilage cell proliferation, retardation of bone formation, fibrosis and granulation tissue, vessels few and irregular. Diaphysitis of decreased vascularization and increased calcification, which is just the reverse of rickets. Periostitis, which rarely occurs alone, but with osteochondritis, shows an osteoid tissue formation.

In viewing the x-ray of congenital syphilis it is found that the epiphyseal area is widened and irregular. There are localized areas of rarefaction in the osseous centers. There is increased density of some or all of the bones. The periosteum may show a perpendicular striation.

In differentiating congenital syphilis from rickets: Syphilis is found in early infancy, while rickets and scurvy rarely before the fourth month; rickets shows a broader, irregular epiphysis; in syhpilitic osteochondritis there are localized areas of rarefaction with intact, dense periphery of the center present.—*C. S. Lowendorf, M.D., Iowa City, Iowa.*

Scleroderma with Sclerodactylia. Louis Edeiken. *Am. J. Roentgenol.*, XXII, 42, July 1929.

Three cases of this rare condition are reported. By x-ray all three showed atrophy and absorption of the extreme tips of the terminal phalanges, giving the appearance of amputation. Two of the three cases presented small calcareous concretions in the soft tissues of the fingers, while the third showed increased calcium content of the end of the distal phalanges.

Bone atrophy and absorption of the tips of the phalanges occurs in Buerger's disease, Raynaud's disease, leprosy and ainhum, but the calcareous deposit also is found

only in sclerodactylia. Chemical examination of the concretions shows them to be composed of calcium carbonate and calcium phosphate.—*C. S. Lowendorf, M.D., Iowa City, Iowa.*

FRACTURE OF LUMBAR TRANSVERSE PROCESS. Case report. Frederick E. Diemer. *Am. J. Roentgenol.*, XXII, 157, Aug. 1929.

This case is reported as an illustration of the fact that by careful study the author finds that the distal fragment of a fractured lumbar transverse process is always displaced downward.—*E. S. Hatch, M.D., New Orleans, La.*

HEREDITARY DEFORMING CHONDRODYSPLASIA. F. Leucutia and A. E. Price. *Am. J. Roentgenol.*, XXII, 338, Oct. 1929.

Two cases of this interesting condition are reported—mother and son. Excellent skiagraphs are shown. The cases show marked similarity; and, the author feels, offer conclusive proof of the hereditary nature of the process.—*E. S. Hatch, M.D., New Orleans, La.*

THE OPERATIVE TREATMENT OF PARALYTIC DEFORMITIES OF THE FOOT. Leo Mayer. *Am. J. Surg.*, VII, 80, July 1929.

The author outlines the operative methods which he has employed during the past five years in the correction of the various types of paralytic foot deformities.

Paralytic valgus: (1) mild grade, due to weakness of the tibialis anticus and tibialis posticus, with no marked bony deformity, is treated by manipulation and immobilization in a position of varus; (2) moderate grade, with paralysis of tibialis anticus and weakness of tibialis posticus and other invertors, with definite bony deformity, is treated by the Hoke stabilizing operation. Inversion can be developed by the synergistic action of the extensor proprius hallucis and Achilles tendon; and (3) severe grade, with complete paralysis of tibialis anticus and tibialis posticus, extensor proprius weak, evertors strong, and marked downward displacement of head of astragalus, is treated by transplanting the peroneus longus or peroneus tertius and extensor longus digitorium to the evertors. The Hoke operation is performed for correction of the bony deformity.

Paralytic varus: (1) mild grade, with weakness of evertors without bony deformity, is treated by transplanting the tibialis anticus or the extensor proprius hallucis to the outer border of the foot by the intrasheath method; (2) moderate and marked grades, with paralysis of evertors and bony deformity of greater or lesser degree, require bone operation. If there is either a tibialis anticus or extensor hallucis suitable for transplantation, the Hoke operation is used, care being taken to resect enough bone from outer portion of astragalocalcaneus joint to permit complete correction of inversion of os calcis. If astragalus is inverted, a wedge resection from the body is done. Then one of the tendons mentioned is transplanted, preferably by the intrasheath route.

If the tibialis anticus and extensor proprius are absent, equinus is usually present. The Achilles tendon is then lengthened and the Hoke operation with the Campbell bone block is done, to prevent the equinus returning.

In the case of equinus deformity with (1) peroneals present, the longus is transplanted to the inner side of the foot by intrasheath route and the brevis to the outside by the subcutaneous route; the Hoke operation is done, also, to prevent a possible varus deformity; (2) peroneals absent, the Campbell bone-block operation is done.

Calcaneus is corrected not by the Whitman operation, but by the Hoke operation modified by the Putti bone block combined with transplantation of the peroneals, the tibialis posticus, and flexor longus hallucis. At least two tendons should be transplanted—one from the outer and inner groups,—by bringing them through a slit in the Achilles tendon and fastening to the os calcis near its posterior tubercle.

In mild cavus deformity the Steindler stripping operation is used. If inversion is present the extensor digitorum longus is transplanted to the outer side of the foot through a drill hole in the fifth metatarsal. In the severe grade with more or less bony deformity,

a wedge is taken through the calcaneocuboid and astragaloscaphoid joints,—the long and short plantar ligaments divided beneath the cuboid and the plantar fascia subcutaneously.

Dangle foot with hip and knee muscles functioning is treated by: (1) Arthrodesis of the astragaloscaphoid, calcaneocuboid, and calcaneoastragaloid joints. The tibiotarsal joint is only partially denuded of cartilage to insure a little motion in the ankle; (2) After arthrodesis the Putti bone block and the Campbell bone block are used. If the knee and hip muscles are weak, complete ankylosis of the entire ankle joint is desirable, and besides arthrodesis a tibial bone graft from tibia to astragalus is used.—*Ruth Jackson, M.D., Iowa City, Iowa.*

RADIOHUMERAL BURSITIS. R. J. Dittrich. *Am. J. Surg.*, VII, 411, Sept. 1929.

After a short review of the literature and a discussion of etiology, trauma and toxaemia, both being important, two cases are discussed, one being operated on and a bursa removed from the region of the radial head which showed marked pathological changes. Relief of symptoms followed removal of the bursa, which was done under local anaesthesia. The second case was bilateral, with recurrences, and was not operated. The author suggests removing all possible toxic elements before resorting to operative removal of the bursa.—*Custis Lee Hall, M.D., Washington, D.C.*

CHONDRO-OSTEO-DYSTROPHY. J. F. Brailsford. *Am. J. Surg.*, VII, 404, Sept. 1929.

This is a well written description of multiple bone changes compared with the normal, and a discussion of the differential diagnosis, including achondroplasia, osteomalacia, cretinism and syphilis.—*Custis Lee Hall, M.D., Washington, D.C.*

THE COLON IN RELATION TO CHRONIC ARTHRITIS. E. C. Fishbaugh. *Am. J. Surg.*, VII, 561, Sept. 1929.

The author feels that most cases of chronic arthritis with gastro-intestinal disease are of the infectious type of arthritis, and found that eighty patients out of 324 adults with infectious arthritis had abdominal pathology, who were free from any other foci of infection. Females predominate in the series, there being sixty-six females to fourteen males, with an average age of forty-seven. Five conditions are found to be of importance: chronic constipation, chronic or subacute colitis, bands and adhesions, diverticulae, rectal crypts and hemorrhoids.

Treatment is along dietary and eliminative lines after surgical rectification of the abnormalities. Stress is laid upon the proper irrigation of the colon, especially in the right-sided ileal stasis type of case. The use of acidophylus culture is also recommended.

Several case reports are added which stress the importance of proper intestinal elimination in this type of case.—*Custis Lee Hall, M.D., Washington, D. C.*

ESSAI SUR LE MÉCANISME DE LA DESTRUCTION TUBERCULEUSE OSTÉO-ARTICULAIRE (INDIVIDUALISATION D'UN NOUVEAU TYPE ANATOMO-CLINIQUE À RECHUTES). [On the Mechanism of the Destruction in Tuberculous Osteo-arthritis (description of an individualization of a new anatomoclinical type with relapses).] Marcel Galland and Herman de Las Casas. *Ann. d'Anat. pathol. medico-chir.*, VI, 375, 1929.

The authors have examined twenty specimens of resections of the knee in order to coordinate the distinct classical tuberculous lesions and to establish the successive stages with their clinical equivalents. In the course of this study they consider they have found a typical lesion characteristic of the relapses in these tuberculous joints.

The authors have discarded the classification of the forms beginning in the bone or in the synovial membrane, and described the evolution of two types. One type develops in the synovial membrane of lesions long superficial; this synovial type may have its origin in a bone as well as in the synovia. The second type is the osseous type, in which

the cartilage is for a long time intact. The origin of this is osseous; the articulation is only slowly invaded. This type develops with relapses.

1. In the type developing in the synovial membrane, the beginning may be either in the bone or in the synovial membrane. The first stage shows peripheal ulceration of cartilage with small peripheral erosions. The cartilage over the areas of compression remains intact in the peripheral tuberculous lesions, not in the central lesions. The second stage shows central ulceration of the cartilage and exfoliation (except with ulceration from central tuberculous lesions). The lesion is a compression cartilaginous ulceration. The third stage is an osseous tuberculous compression ulceration at the areas of the central compression, but sometimes the ulceration is eccentric when there is articular displacement, subluxation, etc. It is seen that the lesions are superficial and become deep only slowly. The evolution is progressive; the lesions are the anatomical lesions of the white swelling of the classical type which develops without injury.

2. The type developing in bone (honeycombed) is another form, distinguished by the subcartilaginous, osteoporous lesions. This osteoporosis is progressive, becomes confluent, and gives rise to actual cavities. The cartilage is very slightly modified and becomes invaginated into these depressions. The articular surface appears honeycombed with scattered nests. Sometimes the cartilage passes like a cover over one of these cavities without dipping into it. It is interesting to note the absence of peripheral sclerosis (often mentioned in resections) and the progressive character of these lesions. The character is quite different from those habitually seen in the juxta-articular cavities. These lesions are those of the first stage. Later the cartilage which covers these cavities becomes perforated, and it would appear that it is this stage, when the joint cavity is involved, which corresponds to the period of relapse. The compression ulceration is shown by the characteristic evidence.

3. The third type, the unicondyloid form, frequently is seen clearly outlined in one of the two condyles, and in this case it is not unusual to find an osseous type in one of the condyles, a primary lesion, and a superficial lesion in the other (which had been involved secondarily).

CLINICAL STUDIES

The corresponding clinical evidences have been most interesting. The forms of the synovial development correspond to the classical white swelling, with a general progression which does not include the possibility of acute periods but without the appearance of a second invasion.

On the other hand, the forms of osseous development correspond clinically to the cases which show relapses.

The honeycombed condition, with small foci, and the subcartilaginous cavities represent a characteristic lesion. The relapses probably appear at the time when the cartilage which covers the cavities becomes perforated and exposes the contents of these areas to the joint cavity. In regard to this the objection may be raised that the subcartilaginous cavity is never other than a juxta-articular cavity, but this is not true, for the cavity is a process clearly limited by a well-formed sclerosed wall. It reabsorbs its contents, either caseous or a sequestrum, or expels it to the outside or into the articulation.

After a period of mild arthritis there develops only slowly a true white swelling of the type of the synovial development. In the osseous forms the process under the cartilage is imperfectly limited, is extensive, and is in close proximity to the articular surface. The limitation by sclerosis appears only late and develops slowly in the osseous form, as in the first periods it is more characteristic than in the cases with the juxta-articular cavities.

The x-rays are for a long time negative. They do not aid in anticipating the existence of this lesion. The proof is the late appearance of the peripheral sclerosis.—*Jacques Calvé, M.D., Berck-Plage, France.*

NON-UNION OF FRACTURES; AN EXPERIMENTAL STUDY. James T. Lacey. *Ann. Surg.*, LXXXIX, 813, June 1929.

This study was carried out upon dogs. An attempt was made to produce experimentally a condition similar to a clinical case of non-union. Fracture was made under anaesthesia by open operation. In some cases the anterior tibial artery was double ligated and cut. In others both the anterior tibial and the dorsalis pedis were occluded. The following conclusions were reached: (1) The clinical picture of non-union can be produced in the experimental animal. (2) Interference with blood supply to the fracture site appears to be an important factor in the development of non-union. (3) Inter-arterial injection of campiodol affords an excellent means of controlling experiments dealing with the vascular system.

This article is very well illustrated.—*F. G. Hodgson, M.D., Atlanta, Ga.*

RECONSTRUCTION OF THE HIP JOINT IN CONGENITAL DISLOCATIONS. Wm. J. Merrill. *Ann. Surg.*, XC, 106, July 1929.

In old unreduced congenital hips, after manipulations have failed, the author advised an open reduction and the formation of a strong, new acetabulum by removing a rectangular section of the upper half of the acetabulum including the roof and the floor. This section is displaced upward and outward and tilted outward, extending this roof well out over the femoral head. The leg is fixed in abduction and this is maintained until the x-ray indicates that the bone will withstand weight-bearing. This position is maintained first by plaster bandages, then a walking brace until stability is assured, even for a period of five years after operation.—*F. G. Hodgson, M.D., Atlanta, Ga.*

ARACHNODACTYLY. M. L. Young. *Arch. Diseases in Childhood*, IV, 190, Aug. 1929.

The author reports four cases which are added to the twenty-two cases already on record. The clinical features of this disease are characterized by an elongation of the phalanges of the hands and feet. These are disproportionately long, the terminal phalanges being more pronounced in length than the remaining divisions. The metacarpal bones in most cases are slightly elongated; the arms usually escape, but the forearm may be abnormally long. The tendency is toward elongation and thinning of the bones toward the ends of the limbs. The musculature is wasted, closely resembling amyotonia congenita. Joints are loose and the ligaments relaxed.

Etiology. Endocrine dyscrasia is rarely seen at birth, when the mother is normal, because of absorption of maternal endocrine secretion. In sixteen of the twenty-six cases the condition was noted at birth. The facial deformities suggest acromegalia, but these disappear in later life. In arachnodactyly the bones are elongated and thinned, while in acromegalia they are decidedly thickened. Each of the author's cases showed a thickening of the anterior and posterior clinoid processes with little or no change in the sella turcica. There was no evidence of pituitary dyscrasia. Mongolism has been considered but the characteristic bony changes are not present in this condition. A form of hyperchondroplasia is ruled out by the normal epiphyseal cartilages. There is no connection with rickets.

Considering a form of primary muscular dystrophy, it is found to simulate closely amyotonia congenita, but bears no connection to other dystrophies. The onset of archnodactyly and amyotonia congenita are both almost invariably intra-uterine. Kyphosis and scoliosis, and marked wasting of the musculature with looseness of the joints, are common to both. Congenital dislocation of the crystalline lens is unknown in the latter, but has been noted in twenty-seven per cent. of the former. The fundamental causative factors of these two diseases are probably the same.

Considering it a fault in the embryo, it is believed that the lens luxates at about the third or fourth month of gestation. Usually the condition does not occur in more than one pregnancy.

Further observations upon the clinical features are noted: the sex ratio is three to two in frequency among females; the elongation of the limbs is greatest toward the

ends; there may be webbing of the fingers. The author found no partial gigantism. There are no rarefactions or evidence of advancement of ossification. The muscular weakness is marked, the consistency of the muscles being that of adipose tissue. The mentality is normal. Dentition was retarded or impaired in thirty per cent. of the cases. The skin showed a dryness and paleness in six of the cases. The hair presented no particular type. The head and face presented abnormalities in sixty-five per cent., and these were mostly signs of acromegalia. The face appeared old for the age. The thorax was abnormal in fifty per cent.; funnel chest was present in twenty-three per cent. The spine presented kyphosis in forty-five per cent. The palate was high in ten of twenty-six cases. The ears were deformed in seventeen cases, enlargement of the lobes being most common. The eyes were deformed in fifty per cent. of the cases. Dislocation of the lens was the most common of the ocular deformities, being present in twenty-seven per cent. It never occurred singly, but was accompanied most often by iridodonesis. The eyes were not reported in nine cases that were mentioned, so the percentage of lens luxation may be higher. The heart presented congenital defects in five cases. The ductless glands were normal, with a possible exception of the pituitary in one case in which autopsy revealed pressure from a bony tumor. The nervous system was normal in all cases.—*C. L. Hawk, M.D., Iowa City, Iowa.*

THE HISTOGENESIS OF VON RECKLINGHAUSEN'S DISEASE. S. H. Gray. *Arch. Neurol. and Psychiat.*, July 1929.

Two cases are presented, with the autopsy evidence in support of the author's contention that these tumors arise from the perineural connective tissue. In the literature there are those who claim that the tumors arise from the cells of Schwann's sheath. In these two cases there is no doubt in the mind of the author that they arose from the perineural connective tissue. Incidentally both of these cases showed fibrosarcomatous changes.—*Jacob Kulowski, M.D., Iowa City, Iowa.*

ZUR KLINIK DER OSTEOCHONDROARTHROPATHIA NECROTICANS VOM KÖHLERSCHEN TYPUS. (Study of the Osteochondro-arthropathia Necroticans of the Köhler's Type.) P. P. Zarenko. *Arch. f. Orthop. u. Unfall-Chir.*, XXVII, 11, Feb. 22, 1929.

Eight years ago Köhler first described the symptoms-complex, since known by the name of Köhler's disease, consisting of an osteochondritis of the heads of the metatarsals.

It is located usually at the head of the fifth, rarely of the third, and still more rarely of the fourth metatarsal head of one or both feet. It is essentially a caries and fibrous osteitis of the head. The patients are usually in the juvenile age. Women are more often affected than men. About 130 cases were collected in the literature by the author, of which not less than sixty-seven belong to the Russian literature. Twenty of these cases were observed in the last three years in the three x-ray laboratories of the author's home city (Taschkent).

The following three stages may be distinguished in the course of the disease:

1. A progressive stage with localized destruction.
2. Full development with fragmentation and arthritis.
3. The quiescent or residual stage with the formation of permanent morphological changes.

The treatment of the condition consists of conservative means such as radiation with ultra-violet light, baths, arsenic therapy, and immobilization. Only exceptionally operative measures are indicated. These consist of resection of the head and implantation of a fascial or fat flap.

In seven cases treated by the author the following results were obtained:

Cured: One case operated and one case treated conservatively.

Considerable improvement: One case treated conservatively and one case operated.

Objective improvement with relief of subjective symptoms: One case conservatively treated.

Arrest of the process: Two cases conservatively treated.

The author draws the following conclusions: According to the pathological, anatomical, and histological, as well as clinical pictures, the name of osteochondro-arthropathia is appropriate for the condition. The histological picture in the author's cases showed a necrosis underneath the articular cartilage, absorption in limited areas, proliferation of granulation tissue, and degenerative changes in the cartilage, all changes corresponding to Axhausen's picture of aseptic necrosis. Clinically osteochondro-arthropathia of the Köhler's type is characterized by its localization and the type of complaint, especially the local and radiating pain, so that a diagnosis even without x-ray examination, is, as a rule, not difficult, though the x-ray findings are of decisive importance.

The conservative treatment of heliotherapy, arsenic, and immobilization of the foot yields good results, but if, in some of the cases, relief is not obtained in the course of one or two months, or if the subjective complaints become acutely increased, then the resection of the head and transplantation of a fat fascia flap is indicated. Although the author believes that the etiology of the disease is primarily static and mechanical, he is not inclined to deny the influence of attenuated infections, of endocrine influences, and of constitutional factors.—*A. Steindler, M.D., Iowa City, Iowa.*

ZUR OPERATIVEN BEHANDLUNG DER SPONDYLITES TUBERCULOSA NACH ALBEE. (The Operative Treatment of the Tuberculous Spondylitis after Albee.) Dr. Joisten. *Arch. f. Orthop. u. Unfall-Chir*, XXVII, 50, Feb. 22, 1929.

After reviewing the literature, the author reports on his own results in the ankylosing method of Albee in cases of tuberculous spondylitis. All in all, twenty-three cases were operated on in a period covering nine years. Albee's technique was used. The aftertreatment consisted of recumbency in plaster bed or upon a mattress for a period of from three to six months, sometimes longer. No brace was worn after that.

Of these twenty-three cases, late results up to fifteen years after operation could be determined in fifteen. With the exception of two patients, all of these cases were individuals in the first and second decades, the youngest being three and a half years old. This child died from shock on the day of the operation. Four other children aged from seven to thirteen years died from two to six years after operation,—three of compression myelitis, and one from meningitis. One patient operated upon under early symptoms of dorsal spondylitis went on to complete paraplegia of both legs. Two patients, one with lumbar and one with dorsal tuberculosis, who, at the time of operation, showed no acute symptoms, were found, nevertheless, to have healed with a progressive deformity, six and thirteen years after the operation. In four patients operated in the latent stage, who had been treated conservatively for years before, the gibbus deformity remained unchanged. As an undoubted success the author reports one case, a child of four, with a dorsal Pott's, operated during the acute stage, who six months after the operation could walk with appliance and without help, and in whom, thirteen years later, the process had healed with formation of very insignificant deformity and development of paragibbary compensatory curve.

All in all, the author finds that the operative results in spondylitic tuberculosis are not very satisfactory. He believes that the graft is not in a position to equalize the deforming forces of mechanical and dynamical nature and that it may become transformed or bent until the natural stop of the gibbus formation is procured by the contact or blocking of two opposing healthy vertebral surfaces. He further believes that, in early cases and in children under twelve years, the operation is, with few exceptions, detrimental rather than useful. He believes that in adult patients the operation in an early stage is justified only when it is followed by recumbency treatment of at least one to one and a half years' duration. Late cases, on the other hand, with moderate gibbus formation and good general conditions, should be subjected to the operation only when, under long continued recumbency treatment in the Lorenz plaster bed, or with supportive apparatus, the process has not been definitely retarded. Here, also, long continued aftertreatment in reclination bed or in corset is necessary. The operation is of

necessity useless in late cases in which no irritative inflammatory symptoms exist, except where the disturbed statics of posture produce static complaints which cannot be met by conservative treatment. He still believes that the method of choice in tuberculosis of the spine is the reclination plaster bed, immobilization, and elimination of weight-bearing, together with fresh air and sunshine.—*A. Steindler, M.D., Iowa City, Iowa.*

SPRUNGGELENKSPLASTIK BEI ANGEBORENER VOLKMANN'SCHER SPRUNGGELENKSMISSBILDUNG UND BEI ANGEBORENEM WADENBERNDEFEKT. (Ankle Joint Plasty in Cases of Congenital Volkmann's Ankle-Joint Deformity and Congenital Defect of the Fibula.) K. Deutschländer. *Arch. f. Orthop. u. Unfall-Chir.*, XXVII, 24, Feb. 22, 1929.

The author considers briefly the current methods for the relief of this very deforming and disabling congenital deformity. The obliquity of the articular surfaces of the ankle joint, which is due to the malformation of the fibula and the unequal development of the tibia, is corrected by the author's method with preservation of the mobility of the joint, and in a manner which reconstructs a sort of mortice similar to that formed normally by inner and outer malleoli. Instead of contenting himself with the simple osteotomy, the author splits the tibia at the border between middle and outer thirds lengthwise for the distance of three to four fingers. Then the medial half of the tibial fragment is separated completely by a second cut running obliquely from below and outward to upward and inward, preserving, at the same time, the periosteal bridge. Then the mobilized median fragment of the tibia is shifted upward against the remaining lateral portion, so that an S-shaped contour is formed. By removing a portion of the articular cartilage of the tibia, the contour formed by the two halves can be so shaped as to simulate a normal mortice. This new mortice consists of the outer portion of the tibia, which takes the rôle of the fibula, and of the overhanging inner half of the tibia which takes the place of the normal inner malleolus. In order to avoid a separation of the fragments, a nail is introduced after obtaining the proper position.

The author reports two cases in which this plastic operation has been performed: one child eight, and one child six years old. The postoperative x-ray pictures show fairly horizontal joint lines, and it is stated that the mobility of the ankle joint is not materially restricted. Since the time of postoperative observation did not exceed five months, no definite statements are made as to the weight-bearing ability of the foot.—*A. Steindler, M.D., Iowa City, Iowa.*

MALIGNANT RHABDOMYOMA OF THE LEFT LEG. Edwin F. Hirsch. *Arch. Pathol.*, VIII, 9, July 1929.

Among the cases accepted by Küttner and Landois as rhabdomyomas of skeletal muscle, three seemed definitely malignant, because of recurrence or histological structure, based on study of tissues obtained surgically. No note is made of the ultimate fate, except in Wolbach's case in which death followed in three months.

CASE REPORT: (J. B.), age six and one-half years.

Painful, hard, uncircumscribed mass in the muscular attachment of the Achilles tendon, July 1927. Regarded as a hematoma-tissue, and removed Dec. 1927. Diagnosis: Sarcoma. In April 1928 a mass was noted in the groin, which progressively increased in size. Mass in groin removed June 1928; was encapsulated. Grossly, on cutting, the surfaces appeared white, opaque, firm, and mottled by faintly yellow necrotic areas.

Histology of the lymph tissues: A delicate fibrous stroma (cells between stroma ten to fifteen microns in diameter) with large, oval, indented nuclei, vesicular in character. Cells definitely arranged around capillaries. The finer details in the cytoplasm varied considerably,—some cells a few coarse basophilic granules, while others were drawn out into slender, or short, plump prolongations with fine longitudinal striations of skeletal muscles. The latter was especially marked in large spindle cells as long as 170 microns. Many cells were found in mitosis.

X-ray examination showed some destruction of the os calcis, but no shadows suggesting growth from bones.

Radiation therapy was then employed.

Oct. 30, 1928. Weight loss, six pounds. Left leg greatly swollen and hard. Upper thigh showed a hard firm mass extending into the inguinal region.

Nov. 1928. X-rays showed bilateral metastasis. Nodules appeared in the abdominal wall. Apathy, weakness, and emaciation progressed.

Died Jan. 1929.

Postmortem: Huge primary rhabdomyosarcoma of left leg with marked extension into left thigh. Extensive metastasis of inguinal, pelvic, periaortic, mesenteric, retroperitoneal, biliary, perisplenic, mediastinal, peribronchitic, and left axillary lymph nodes, and of the lungs, urinary bladder, abdominal wall, skin of the genitals, tissues of the left chest. Erosion of the superior ramus of the left pubis and left fibula. Bilateral hydronephrosis, ulceration of the lining of the inferior vena cava. Bilateral hydrothorax, marked emaciation and marked oedema of left thigh and leg.

Histological structure of all metastasis resembled that already described.—*D. C. Keyes, M.D., Iowa City, Iowa.*

THE AVIAN, HUMAN AND BOVINE TUBERCULIN REACTIONS IN CHILDREN, WITH REVIEW OF LITERATURE OF AVIAN TUBERCULOSIS IN MAN. B. M. Gasul, Chicago. *Arch. Pediatrics*, XLVI, 67, Feb. 1929.

The author gives a history of the discovery of the three types of tuberculosis,—namely, human, bovine, and avian. The two former types have long been recognized in the human, but not often the last. This last, however, has been discovered in children and young adults by a number of Europeans. The first to be reported in America was in 1926, by Wm. Mayo and Hendricks.

The pathological picture is an enlarged spleen, prolonged fever which may continue for two years, low in the morning and as high as thirty-nine degrees centigrade in the evening. The kidneys and bone marrow are the areas of predilection. Definite tubercles are formed which contain giant cells and large epitheloid cells, but no caseation.

The von Pirquet test with avian tuberculin gives no reaction in either the human or bovine tuberculosis as tried on 110 cases by the author. But the course of avian tuberculosis responds favorably to treatment by avian tuberculin. Guinea pigs are immune to the avian type, but rabbits and fowls are not.

Infection takes place through the gastro-intestinal tract. The organism in the eggs of infected hens has been found viable in soft boiled and mildly cooked hard boiled eggs. The veterinary journals report avian tuberculosis present in almost every part of America.—*C. L. Hawk, M.D., Iowa City, Iowa.*

TUMORS OF THE BONE. William H. Goodwin. *Arch. Surg.*, XVIII, 2353, June 1929.

The author discusses the classification, etiology, and treatment of sarcoma of bone, and reports ten cases of bone tumors. Six were typical cases of periosteal sarcoma, and in five the limb was amputated. All died of metastasis. Two had typical giant-cell sarcomas, one of whom had the limb amputated for pathological fracture and the other received roentgen-ray treatment with marked increase in formation of new bone throughout the tumor. Two were borderline cases, standing between the benign giant-cell tumor and the periosteal sarcoma; both had the limbs amputated and are well two years later. The Committee on Bone Sarcoma studied the cases and classified one as a mixed-cell sarcoma of low grade malignancy and the other as an osteogenic sarcoma of low type.

The author recommends radical amputation, combined with radiotherapy and the mixed toxins of Coley for treatment.—*E. M. Cowart, M.D., Iowa City, Iowa.*

Loose Cartilage from Intervetebral Disk Simulating Tumor of the Spinal Cord. Walter E. Dandy. *Arch. Surg.*, XIX, 660, Oct. 1929.

In two cases developing paralysis resulting from pressure on the cauda equina, operation disclosed intraspinal tumors originating from injured intervetebral disks and behaving like joint mice. Laminectomy and removal of the cartilage is offered as the curative method.—*I. William Nachlas, M.D., Baltimore, Md.*

Experimental Sarcoma of Bone. Charles L. Connor. *Arch. Surg.*, XIX, 794, Nov. 1929.

Injecting dried tumor substance obtained from a spontaneous chicken endothelioma into the marrow cavity of chickens, Connor studied, first, the similarity of the newly formed neoplasm to the Ewing tumor; second, the process of growth of a bone tumor; third, the reaction of the bone to the growth. He found that the newly formed mass resembled endothelioma in that it occupied a large part of the shaft and was osteolytic, but while within the confines of the periosteum radiating spicules were formed. Palpatory and x-ray recognition of the tumor was possible only after two-thirds of the course had been run, though autopsy showed the growth as soon as four days after injection. It was also found that both endothelial cells and fibroblasts can form osteoblasts.—*I. William Nachlas, M.D., Baltimore, Md.*

Distrofia di Crescenza Calcaneare Posteriore [Dystrophy During the Growth of the Posterior Calcaneous (Apophysitis Calcanei), followed by Schlatter's Disease]. G. Giraudi. *"Atti" del Raduno Radiologi dell'Alta Italia Brescia-Gardone*, VI, Oct. 22, 1928.

The author cites the case of a boy aged eleven years, who showed a unilateral "apophysitis calcanei"; afterward, at the age of thirteen, a bilateral Osgood-Schlatter's disease. The radiograms confirm the opinions of Bergmann (1926) and Merlini (1928), who maintain that the x-ray syndrome of this "apophysitis calcanei" has not been established, for they do not differ from the radiograms seen in the normal calcaneum.

Sindrome di Sinding Larsen e Aspetto Tigrato della Rotula (Syndrome of Sinding Larsen, and the Spotted Appearance of the Patella). G. Giraudi. *"Atti" del Raduno Radiologi dell'Alta Italia Brescia-Gardone*, VI, Oct. 22, 1928.

Sinding Larsen calls the "patellitis adolescentium" a disease which he considers as a periosteitis of traction. Van Neck is of the opinion that a tendonitis of the patella tendon, developing at the point of tibial insertion of the patella tendon, produces the appearance of Osgood-Schlatter's disease, while the pull at the point of insertion on the patella itself produces the syndrome of Sinding Larsen. The case of Dr. Giraudi, which was sent for a radiographic examination with the clinical diagnosis of Schlatter's disease, showed by the x-ray the spotted aspect of the patella without a lesion of the tibia.

An Incision for Direct Exposure of the Whole Humerus. George A. Mason. *British J. Surg.*, XVII, 30, July 1929.

The author describes an incision for direct exposure of the whole humerus. This is an incision which is very sound and practical in a case of extensive osteomyelitis, or very convenient in those commonly occurring cases where only one segment of bone seems to need exposure, because, if necessary, it can be extended upward or downward with impunity. The line of the incision starts at the tip of the acromion, extends down along the outer border of the biceps, and terminates at the middle of the bend of the elbow. The deltoid is split in the direction of its fibers between the small clavicular and larger scapular portion of the muscle and passes below through the apex of its V-shaped insertion. Continuing downward, the biceps is retracted mesially and the brachialis anticus is split in the direction of its fibers along the anterior crest or border of the humerus until the anterior capsular fibers of the elbow joint are exposed.

The author points out the following advantages of this incision:

1. The cephalic vein is not interfered with.
2. The musculospiral nerve is not seen—it being retracted laterally since it lies in a groove along the lateral edge of the brachialis.
3. The musculocutaneous nerve in the lower part of the incision lies on the portion of the brachialis anticus that is displaced medially.
4. The innervation of the anterior deltoid (circumflex) as it crosses the humeral shaft can be avoided by subperiosteal dissection, if bone exposure above this level is necessary, or, if this branch has to be divided, only the small anterior portion of the deltoid (less than one quarter) is thrown out of action.—*L. J. Miltner, M.D., Iowa City, Iowa.*

THE CAUSATION OF MULTIPLE EXOSTOSES. J. B. Hume, London. *British J. Surg.*, XVII, 236, Oct. 1929.

The tarsus, carpus, skull, sternum, and vertebrae as well as the epiphyses of the long bones escape these abnormalities, only those in which an additional membrane bone is laid down subperiosteally over endochondral bone being affected. Frequently the condition is hereditary.

Two types are mentioned,—those appearing in the region of active growth near the extremities of the long bones, and those appearing near the secondary centers of ossification. During the period of growth of the exostosis, growing cartilage is found on its surface.

The theory is offered that this cartilage comes from the growth disc, the edges of which have become pulled upwards over the surface of the metaphysis. "An abnormal stimulus, affecting the center of the disc alone, and interfering with the process of ossification, would produce an enchondroma, one affecting a localized portion of the periphery, a single pedunculated exostosis; while a more general stimulus affecting the growth discs of all the long bones would produce multiple exostoses."

FOCI AND NATURE OF INFECTION IN 100 CASES OF RHEUMATIC CONDITIONS. E. Cronin Lowe. *British Med. J.*, II, 43, July 13, 1929.

The author gives an analysis of 100 cases, clinically belonging to the group of rheumatic infections, which were examined for evidence of focal and bacterial infection by the pathogen selective method. This method depends upon exploring freshly drawn blood from the patient to determine, by the presence or absence of efficient bactericidal power, whether any of the organisms present in suspected foci of infection are or are not pathogenic to the salient concerned. An average of three specimens per patient were examined.

By this method one infective focus only was suggested in twenty-eight of the cases. In the remaining seventy-two cases more than one focus was responsible for the infection. It was found that the clinical importance of infective foci was: first, postnasal and accessory sinuses; second, intestinal, tonsillar, and dental foci. The evidence of organisms isolated showed that the streptococci group predominated, but that practically any other commonly present organism may be important in any individual case.

It is apparently possible to determine which or how many of the suspicious foci in any patient are infectious and which are not. Radical or conservative treatment, therefore, may be indicated in any case. The employment of rational and exact vaccine therapy is possible because this method indicated the organisms present against which the patient has lost resistance, and for which an active immunity should be developed.

The results of treatment are not given here, but will appear later.—*Ruth Jackson, M.D., Iowa City, Iowa.*

OPERATIVE TREATMENT OF TUBERCULOSIS OF THE LARGER JOINTS. G. R. Girdlestone. *British Med. J.*, II, 529, Sept. 21, 1929.

Girdlestone opened the discussion on the above subject before the British Medical Association with the paper which is here reviewed. After defining the limits set to his paper by the title of the subject, he proceeds to a timely discussion of what consti-

tutes surgical tuberculosis. He rightly points out that tuberculosis in a joint is but a local manifestation of a systemic disease. "Tuberculous disease in a joint itself is serious enough, but it is a weed with a very deep root. You may pluck the head but the root will not come with it." A bone focus is a proof of established tuberculous infection in the body, and the new focus is tangible evidence that the invasion of the body is progressing. He does not think that bone foci of themselves commonly are foci from which bacilli are disseminated to other parts of the body. Dissemination of the disease comes from deeply seated tuberculous glands. Operative treatment of tuberculous joints can only result in cure of the diseased joint, and does not modify the more deeply seated disease from which it arose. This distinction is important. If the patient is suffering seriously from his systemic infection, operation upon the joint should be postponed until conservative measures have given him an opportunity to gain the mastery of the deeply seated tuberculosis.

The author advocates arthropsy for early diagnosis. For treatment, he divides patients into two groups,—adults and children. In the former, he thinks radical operation (excision or arthrodesis) should be the rule, and should be undertaken as soon as the patient's general health is improving. Certain joints (hip and sacro-iliac), because of anatomical structure, require extra-articular fusion. In children, the same treatment is indicated when the damage to the joint is extensive. For the knee, he advocates excision; for the sacro-iliac joint, extra-articular reinforcement; for the hip, extra-articular fusion by grafts or excision followed later by fusion; for the ankle, amputation as a rule, but occasionally if the disease is limited to the astragalus, astragalectomy; for the shoulder, excision and arthrodesis.—*R. I. Harris, M.D., Toronto, Ont.*

THREE HUNDRED CASES OF TUBERCULOSIS OF THE HIP JOINT. C. Lee Pattison. *British Med. J.*, II, 532, Sept. 21, 1929.

Pattison reports the results of treatment of three hundred cases of tuberculosis of the hip personally observed by him in the King Edward VII Hospital at Sheffield. He emphasizes first the need for accuracy in diagnosis, and in this connection stresses the importance of typical x-ray changes or the finding of tubercle bacilli in the pus from a tuberculous abscess. Treatment of his cases was conservative and he divides it into three stages: (1) Acute stage, treated by immobilization in bed with extension until muscle spasm is overcome. (2) Transition stage. During this stage, an attempt is made to foretell whether the patient will recover with a movable joint or whether ankylosis will take place. The former group is treated by continued recumbency but without fixation or extension. The latter group is fixed in a plaster spica which includes the thigh on the good side also. (3) Convalescent stage—ambulatory, with crutches and a patten on the good side. Celluloid spica for those cases which are proceeding to ankylosis. His results are amazing. Of three hundred cases, one hundred sixty-seven recovered with full range of movement; ninety-seven recovered, but with limited movement, ankylosis or deformity. In forty-four cases, the disease recurred, and thirteen patients died. It is difficult to understand these results in the light of experience with similar cases on this continent.—*R. I. Harris, M.D., Toronto, Ont.*

TREATMENT OF TORTICOLLIS. B. Whitchurch Howell. *British Med. J.*, II, 714, October 19, 1929.

Howell, in a paper read before the Orthopaedic Section of the British Medical Association, discusses the treatment of torticollis. He classifies torticollis into two groups,—congenital and acquired. The former group includes all the cases due to shortening of the sternomastoid muscle, and the latter all the types due to causes other than shortening of the sternomastoid. His treatment varies, depending upon the age of the patient when first seen. Early cases are treated by stretching; late cases by subcutaneous tenotomy of the sternal head of the sternocleidomastoid muscle. Plaster cast is used after tenotomy. He obtained nineteen cures in twenty cases.—*R. I. Harris, M.D., Toronto, Ont.*

DAS RÖNTGENOLOGISCHE BILD UND DIE KLINISCHE BEDEUTUNG DER SOGENANNTEN KNORPELKNÖTCHEN DER WIRBELSÄULE. (The X-ray Appearance and the Clinical Significance of the So Called Cartilaginous Nodules of the Vertebral Column.) Walther Müller. *Bruns' Beitr. z. klin. Chir.*, CXLV, 191, 1928–1929.

The author substantiates the pathological findings of Schmorl, and presents a series of cases in which the syndrome has appeared.

Schmorl directed attention to the intervertebral disc. Normally, this is firmly attached to the compact bone of the body around the margins. Towards the center the disc is less firmly attached to the spongiosa of the porous vertebra and is covered by a hyaline cartilage layer which enters into the porous structure of the vertebra. The disc, in the adult, is without blood vessels and is nourished by tissue fluids derived for the main part from the spongiosa. The nucleus polposus, situated back from the center of the vertebral body, is the site of considerable elastic stresses normally. Thus, if the surrounding ligaments are cut, the disc will force the vertebrae apart and assume the more circular shape as seen in fish vertebrae.

Schmorl described a syndrome wherein the disc tissue, fibrous tissue, and cartilage penetrated over a large or over a small area into the spongiosa of the body. Bone formation occurred on the margins of these lesions so that they were made visible on the x-ray plate in Müller's series. An osteomalacia or osteoporosis (or "insufficiency"), according to Schantz, seems to be a necessary precursor. Trauma may or may not be presented in the history. The lesions appear most frequently towards the latter portion of adolescent growth, and are most common in the lower dorsal and upper lumbar regions. Various complaints are found in association. Some, however, are unaccompanied by symptoms. Local diminution of motion, spinous process tenderness, and a slight kyphosis may be apparent.

In all, the author presents five cases to substantiate the pathological contentions of Schmorl. In one of these the roentgenological picture found corroboration in the pathological section, as excellent reproductions testify. Müller observes that by no means every case presenting this syndrome will have symptoms. Thus thirty-eight per cent. of Schmorl's routine postmortem examinations disclosed this condition, yet some cases do have such symptoms, and it is in these that the diagnosis is of therapeutic interest.

In conclusion, the author feels that the condition may be the basis of the kyphosis of adolescence whose pathogenesis continues to be a matter of doubt. Schmorl, on the contrary, has examined corpses of twenty-five adolescents in whom a kyphosis existed and has found no trace of the syndrome.

The article merits careful perusal.—*J. E. Milgram, M.D., Iowa City, Iowa.*

SPONTANE AUSHEILUNGSVORGÄNGE BEI GENERALISIERTER OSTEODYSTROPHIA FIBROSA. (Spontaneous Healing of Generalized Osteodystrophia Fibrosa.) C. Th. Willich. *Bruns' Beitr. z. klin. Chir.*, CXLVI, 103, 1929.

The author reports the first instance of a case of generalized von Recklinghausen spontaneously involuting with complete disappearance of tumors in some regions. Roentgenograms of 1912 and 1928 are reproduced in evidence.

The patient, an opera singer in earlier years, now aged fifty-six, had suffered for thirty years with the malady. In 1902 an epulis was removed by Riedl. Within the course of the next two years there developed large bony tumors in both lower extremities. Femora and tibiae became more and more bowed and a severe kyphoscoliosis appeared. The patient was confined to a wheel chair. Tumors of the mandible became palpable in 1904. In 1908 a pathological fracture of the left femur occurred, followed by healing in six weeks. The maxillary tumors became so troublesome that in 1912 Lexer performed a bilateral maxillary resection. X-rays of the skull were suggestive of Paget's disease. Since 1914, however, spontaneous improvement has steadily taken place. Walking is now possible. Tumors of the ulna, metacarpals, humerus, and skull have regressed markedly and in some instances disappeared.

Pathological sections of tumors were presented to the forty-first congress of the German Society for Surgery in 1912 by Wrede, who termed them "ossifying giant-cell sarcomas".

The case is a remarkable one and is of particular interest in view of the fact that the etiological connection of the parathyroid gland with this condition has been definitely established. Willich is apparently unaware of the reports of Gold and Mandl on hyperparathyroidism and that Duken has reported so called "giant-cell tumor" excised in a case of hyperparathyroidism. The rapid cure of the condition by removal of parathyroid tissue (adenomatous or normal) makes the recognition of the syndrome a matter of considerable importance. In this case it may be possible that a parathyroid adenoma was present which underwent spontaneous disintegration as do occasional thyroid adenomas. With disintegration we can postulate a reduction in the level of the parathyroid hormone in the body with a consequent return to a comparatively normal state. —*J. E. Milgram, M.D., Iowa City, Iowa.*

Operative Behandlung der Luxation des Radiusköpfchens nach vorn. (Operative Treatment of Anterior Dislocation of the Radial Head.) René Sommer. *Bruns' Beitr. z. klin. Chir.*, CXLVI, 265, 1929.

While lateral dislocations of the radial head are seldom overlooked, anterior luxations frequently slip by unnoticed, to later cause severe impairment of elbow function. If complicating ulnar fracture, reduction of the latter is almost impossible The procedure usually recommended after reduction, because of the tendency of the biceps to subsequently cause redislocation, is reconstruction or rather simulation of the annular ligament. This simulation usually entails passing a fascia lata band around radius and ulna.

The author recommends a much simpler procedure. He passes a fascia lata band around the anterior surface of the radial neck and passes the free ends of the band through the bronchioradialis muscle mass behind the head. These ends are then sewed together. Pronation and supination are not interfered with and anterior luxation is effectually prevented. A case in point is reported. The modification seems worthy of emulation.—*J. E. Milgram, M.D., Iowa City, Iowa.*

Über den Bruch des Wirbeldornfortsatzes durch Muskelzug. (Concerning Fractures of Spinous Processes Through Muscle-pull.) W. Boss. *Bruns' Beitr. z. klin. Chir.*, CXLVI, 194, 1929.

After reviewing the thirteen cases in the literature, the author reports an additional case. The patient, a muscular male of nineteen, pushed a heavy load forward and in the moment of maximum exertion became aware of a cracking noise and pain between his shoulder blades. He continued working in spite of the pain and increasing disability for the next eight days, when he found it impossible to elevate the arms beyond a horizontal position. A lateral view (x-ray) of the upper dorsal spine revealed a fracture of the tip of the first dorsal spinous process. In the anteroposterior view, the appearance of a bifid process was simulated.

Healing occurred after bed rest of three to six weeks in most of the cases reported previously.—*J. E. Milgram, M.D., Iowa City, Iowa.*

External Bone Plating for Long Bones. Charles A. Dukes. *California and West. Med.*, XXX, 328, May 1929.

By Dukes' method the external plate is fastened to four long bolts screwed into the bone, two on each side of the fracture. The bolts used are ordinary screw-headed bolts of malleable steel with the screw end pointed. They are put into the bone with a screw driver through puncture openings. These puncture openings through the soft tissue are made with a trocar under a fluoroscope, the trocar being removed and its shield left in place to guide the screw bolt.

This method was the result of trials of many different kinds of bolts and technique. At first, holes were drilled preliminary to inserting the bolts, but it was found that a firmer hold could be obtained by making bolts sharp at the end and forcing them in with a screw driver. The article does not make clear, either in text or illustrations, the details of fastening the external plate to the bolts.

The apparatus is easily removed after two to four weeks. The method is only advocated for those cases in which simpler procedures fail.

In the discussion of this paper the following points are brought out:

(1) The Dukes' method is not merely a revival of the old Lambotte's bone plate but an original idea; (2) infection is not common because there is an outward flow of serous exudate; (3) the bolts should be screwed clear through the bone to insure against loosening.—*William Arthur Clark, M.D., Pasadena, Calif.*

Injuries to the Back. Halbert W. Chappel. *California and West. Med.*, XXXI, 180, Sept. 1929.

Any discomfort in the back developing while at work becomes an industrial accident case. If no disease is present, most sudden sprains of the back should recover in a few days. Should the sprain be sufficient to tear ligaments or muscles, recovery will require a few weeks. Severe trauma causing bone lesion but without paralysis will need six to nine months' treatment.

However, if disease such as arthritis, osteomyelitis or latent tuberculosis is present, or if there is a congenital abnormality, the disability is indefinitely prolonged. A fifth lumbar vertebra with abnormally long transverse process impinging on the ilia or fusing with the sacrum is a frequent cause of delay in recovery. Scoliosis and abnormal anteroposterior curves are also sources of weakness and prolonged symptoms. Foci of infection such as prostatitis and pelvic conditions should also be mentioned as preventing early recovery.

The mental attitude of the patient is very important. Hopefulness should be encouraged, because many people regard a fracture or other injury to the back as a more or less permanent disability.

In discussing treatment, emphasis is laid on active rather than passive methods. To insure early return to work the patient should be urged to do active exercises as soon as possible. This prevents adhesions and hastens return of muscle tone. The routine treatment of prolonged rest in bed, baking, girdles, braces, and plaster jackets gives the patient the impression that his injury is very serious and that he may never get well. Passive treatment of back injuries is a very common but a very expensive method.—*William Arthur Clark, M.D., Pasadena, Calif.*

Sulle Fratture del Polso con Speciale Riguardo ai Loro Esiti Remoti. (Fracture of the Wrist with Special Reference to Remote Results.) L. Torchiana. *Chir. d. Org. di Movimento*, XIII, 425, June 1929.

Among 2,000 cases of fractures of all kinds those of the wrist constitute about four and eight-tenths per cent. The author emphasizes that a perfect result of a fracture of the wrist, especially a Colles' fracture, cannot be obtained unless there is good reduction, and, in general, the late disabilities are the lesser, the better the preceding reduction. But it must also be pointed out that the principal factor of success lies not so much in the immediate as in the subsequent postreduction treatment of the fracture. He calls attention to the fact that any immobilization of the fractured wrist which includes the fingers as well is dangerous, and that it is an absolute necessity not to prolong immobilization itself beyond a certain necessary minimum. Hot baths, massage, and active and passive movement must be instituted at the earliest possible moment. Reduction and application of an apparatus are, of course, necessary, but it is commonly observed that a definite result, especially in Colles' fracture, is better when the patient is left to himself than it is under inadequate treatment, especially one which includes too long immobilization.—*A. Steindler, M.D., Iowa City, Iowa.*

Apofisi Stiloidi Nelle Vertebre Umane. (The Styloid Apophyses in the Human Spine.) A. Nicotra. *Chir. d. Org. di Movimento*, XIII, 468, June 1929.

In a very recent communication, Prof. Putti and Dr. Mandruzzato described the radiographic picture of styloid apophyses in the human spine. The same observation was made by the author in his radiographic studies.

The texts on the normal human anatomy describe, at the basis and posterior surface of the costiform processes of the lumbar spine and posterior to the articular processes, two tubercles,—namely, the mammillary above and the accessory tubercle below. The development of these two tubercles varies, and they are often represented by rudimentary spurs or spikes. According to the investigations of the author, the presence of a true styloid apophysis in this region which measures more than four millimeters in length is not frequent; on the other hand, the accessory tubercles in form of nodes or spicules are not infrequently formations of about two millimeters in length. These formations are very well demonstrated in a number of radiograms presented by the author. No pathogenic importance is attached to these formations, as has already been pointed out by Putti and Mandruzzato. At least there is no connection to be construed between sensory symptoms and the formation of these bony projections. The presence of these styloid apophyses was known already to Broca and Topinard, and was studied more recently by Le Double. Since then very little has been contributed to our knowledge. The recognition of these apophyses as normal physiological formation is very important if one is to avoid erroneous interpretations of radiograms.—*A. Steindler, M.D., Iowa City, Iowa.*

Le Dislocazioni Temporanee dei Capi Articolari nella Cura dei Più Gravi Processi Settici dell' Articolazione Tibio-Astragalea. (Temporary Dislocation of Articular Bodies in the Treatment of Severe Septic Processes of the Tibio-Astragaloid Articulation.) Attilio Odasso. *Chir. d. Org. di Movimento*, XIII, 478, June 1929.

The author reports cases in which this formidable procedure was performed, and he is convinced of the merits of the method. From the study of the clinical reports and from prolonged and minute observation of the patients it has become apparent that all cases in which the dislocation of the tibio-astragaloid articulation was produced in order to control the local and general sepsis showed a constant and prompt response to this method. The sepsis yielded within a few days, the temperature coming down, the swelling gradually diminishing, and the phlegmonous symptoms within the tendon sheath and peri-articular tissue gradually subsiding. In those cases in which the operative dislocation was done immediately after the advent of the trauma, in order to allow accurate dissection of the site of the compound and comminuted fracture, to insure adequate drainage and prevent infection of the injured parts, no symptoms of general sepsis occurred at all. The temperature was never much elevated, and such elevation as was present was limited to a few days immediately following the trauma.

A subsequent reduction of the dislocated foot could be accomplished, on an average, within thirty days, which time was necessary in order to obtain complete realignment of the parts and the appearance of healthy granulation. As far as the operative dislocation was concerned, the position of the dislocated foot in plaster was well tolerated and there were no complaints on the part of the patient. In no instance were there observed ischaemic symptoms, even where the dislocation had to be extreme in order to obtain sufficient drainage.

The resection of the inferior epiphyses of the tibia and of the fibula was necessary in order to obtain correct reduction of the foot, in cases in which these parts had not already been resected primarily or had not been eliminated in the form of sequestra as a result of the trauma. Such resection, however, was never accompanied by rises in temperature and the small operative act was well tolerated by the patient. The resulting tibiotarsal ankylosis proved to be perfect in function and completely painless. In some cases a very solid tibiotarsal callus was formed, while in others a pseudarthrosis, though painless and very favorable to the function of the foot, had developed.

The average shortening varied from two to six centimeters. Brilliant and comparatively rapid results were obtained in six out of the eight cases, and in only two the desired result was not obtained; one had to be secondarily amputated,—it was an old, decrepit, and marantic individual. In another healing was retarded and ulceration of the leg persisted.

The technique of the operative interference naturally varies. The foot can be dislocated either in median or lateral position,—that is, in adduction or abduction. The median dislocation is more favorable for the preservation of the circulation, since the posterior tibial vessels are not approached. For the median dislocation the ordinary retro-malleolar incision (Kocher) is best. An internal retromalleolar incision may be utilized for the lateral dislocation of the foot. One must take particular care not to injure the posterior tibial vessels. The deviation of the foot should be limited to the indispensable minimum necessary to control the sepsis, and should be such that the circulation of the foot does not suffer. One must also take care not to dissect free too much of the bone.

The luxated foot is fixed in its new position by a plaster bandage; a spacious window permits the supervision of the wound and every eight to ten days the plaster bandage can be renewed. As soon as the infection is controlled, adduction of the foot to the normal position is begun; this new plaster bandage is applied at right angle and is kept in place from four to five months, after which time the patient is allowed to walk, with an appropriate shoe.

For the dislocation toward the median side the already mentioned Kocher incision suffices; the external collateral ligament and the peroneal ligaments are divided, the tendons of the two peroneals are cut, and the foot is dislocated by strong inward rotation, or varus position. In order to obtain lateral deviation of the foot it is necessary to incise the internal ligament, the collateral ligaments of the tibia or deltoid ligament, the capsule, and the tendons of the posterior tibial muscle, eventually the flexor of the great toe. Then only can the foot be rotated outward and dislocated.

In conclusion, the author reviews the different indications existing in severe sepsis of the ankle joint. Primary resection of the synovia, of the articular capsule of the foot, and secondary resection of the tibiotarsal articulation, accompanied or not by astragalectomy, all have their precise indications relative to time of interference, seat of the infection, and severity of the lesion. When these interventions are indicated, and are rationally carried out, really brilliant results can be obtained. The amputation should be reserved for only the gravest cases with very extensive destruction of the soft parts, and cases which are in poor general condition.

The arthrotomy or the arthrostomy can always be attempted in the treatment of purulent arthritis in the large articulations and also of the ankle joint, for which procedure the posterior incision is to be preferred. These, however, will rarely succeed in arresting septic processes of a certain extent and virulence. Here, dislocation of the foot with the axial deviation of the articular head as described in this paper is particularly useful, and it is almost indispensable for the conservation of the limb and of the life of the patient in compound fracture dislocations, in wounds of the tarsus complicated with severe purulent arthritis of the tibiotarsal articulation and with grave local and septic complications. The dislocation must be ample and undertaken at a timely date. The reduction to correct position must be carried out with the greatest possible care and precaution. The aftertreatment must be carried out strictly and methodically.—*A. Steindler, M.D., Iowa City, Iowa.*

CURA DELL'ASSENZA CONGENITA DELLA TIBIA O DEL PERONE. (Treatment of the Congenital Absence of Tibia and Fibula.) V. Putti. *Chir. d. Org. di Movimento* XIII, 513, June 1929.

The aims of the treatment are: the proper alignment of the three skeletal segments—namely, tibia-fibula, femur, and foot—for the production of a solid column of support; if possible, the lengthening of the affected limb.

In case of absence of the tibia, a fibula is substituted for it, which above is made to articulate or to be ankylosed to the femur above; and below, if there is no lower tibial epiphysis, is made into a bone graft set into the tarsus. The foot, with the exception of the toes, is aligned with the axis of the limb and utilized as a segment of the lengthening of the longitudinal axis of the limb.

In congenital absence of the fibula the procedure naturally extends to the foot only and consists of alignment and implantation of the tibia into the tarsus.

Twelve patients were operated on by this method, five of whom were afflicted with total absence of the tibia, three with partial absence, and four with absence of the fibula.

A paramedian longitudinal incision lateral to the midline of the knee is made from the level of the suprapatellar pouch downward to the full upper third of the leg. After incision of skin and fascia the articular cavity which contains the remaining femoral epiphysis is opened, the capsular tissue interposed between femoral epiphysis and peroneal epiphysis is removed, and the intercondyloid space is cleanly dissected. This is not an easy manoeuver because of the muscle masses which hold the peroneal epiphysis upward and laterally to the femur. In some cases up to three centimeters of the peroneal epiphysis had to be resected in order to bring it into alignment with the femoral epiphysis. In other cases it was possible to do so by simply lengthening the tendon of the biceps; then with flexion and adduction manoeuvers of the limb the epiphysis of the femur could be planted into the intercondyloid notch. Never was it possible to hold this position with the knee in complete extension, but a certain degree of flexion had to be maintained. When this placement of the upper end of the fibula was accomplished, synostosis between fibula and femur was carried out. The ideal procedure would be the establishing of a nearthrosis of the knee, but the arthrodesis is much easier to obtain than the nearthrosis.

In case of total absence of the tibia in its lower portion, the implantation of the fibula into the tarsus is to be considered. According to the case, one will find the fibula articulating with the astragalus, or in the absence of the latter, with the os calcis. Usually, as soon as the articulation is laid bare, the foot can be brought to align itself with the axis of the fibula. As soon as this alignment is obtained the astragalus is split longitudinally, or, in its absence, the os calcis, so as to provide a trough into which the lower end of the fibula is inserted. The foot is placed in equinus position to obtain the desired lengthening of the extremity. In cases of partial defect of the tibia—of its lower portion—Putti limits himself to the implantation of the fibula upon the tibia by graft above and to the implantation of the fibula into the tarsus below. If, conversely, only the upper epiphysis of the tibia is missing, then it is sufficient to reconstruct the missing epiphysis, using the fibula. If only the diaphyseal portion of the tibia is missing, one uses a fibula, attaching it both to the upper and lower remaining portion of the tibia.

In the eight cases presented by Putti as being completely treated and having records of late results, it was found that the end result corresponded entirely to the expectations, and the limb, provided with proper prosthesis, served as a solid prop of support with a painless and steady gait. Under the functional influence the fibula acquires the proportion of the tibia. The synostosis between tarsus and fibula remains solid as does also a femoral tibial arthrodesis. Only in one case, in which a nearthrosis of the knee joint was attempted, he found that the operative result was not the desired one, since, in the course of time, ankylosis of the knee appeared. This, however, did not interfere with steady and painless gait. Putti still believes that such an objective can be obtained, and that it is possible by operation to secure a nearthrosis with moderate range of motion. —*A. Steindler, M.D., Iowa City, Iowa.*

INDICATION AND RESULTS OF OSTEOSYNTHESIS (FUSION) IN THE TREATMENT OF POTT'S DISEASE, by Rocher of Bordeaux and Sorrel of Paris. A report delivered before the *Thirty-eighth French Congress of Surgery* held at Paris, October 1929.

The report of Rocher and Sorrel which, when printed, covers approximately one hundred and fifty pages and includes a complete bibliography of the subject, furnishes a

critical survey of the history, pathology of Pott's disease, operative indications and results of fusion operations for the spine. It is based partly on the personal experience of the authors in hundreds of clinical cases and partly upon the answers to a questionnaire which was sent to prominent orthopaedic surgeons in almost every country of the world.

The authors believe that in children the operative fusion is unnecessary because a spontaneous fusion occurs. It is their impression that the operation itself does not exercise a corrective effect upon the pathological process and does not materially diminish the period of recumbency. In adults, however, a spontaneous fusion seldom occurs and the operative procedure is of definite value. Of thirty-seven French surgeons who responded to the questionnaire, twenty-seven favored the operative procedure in adults. In all other countries, with the exception of Germany, practically all surgeons were of the same view. Of the adults, only about one-third of the cases treated by the authors were considered suitable for operation. Contraindications were poor general condition, complicating pulmonary or visceral tuberculosis, and unsuitable local operative conditions such as a thin, scarred skin and discharging sinuses. Of the 201 cases which were operated on, 169 were over twenty years of age. There were none under fourteen years of age. There were no cases over fifty.

The time of operative intervention has been the subject for much discussion. Rocher and Sorrel disagree radically with Albee and Hibbs, whose principle it is to fuse the spine as soon as the diagnosis has been made. The French authors are of the opinion that operation must be deferred until in the natural course of the disease a period of repair has started. Pott's disease has a definite cycle beginning with the preliminary stage, which may be so insidious as to resemble the onset of a typhoid fever. This is followed by the stage of evolution. In this the lesion, which at first was localized in one or two vertebrae, tends to spread to the adjacent bones. During this stage abscesses form and paraplegias may develop. An operative fusion during either the first or second stage has had, in their experience, little or no influence upon the lesion. In the third stage of the disease the reparative process begins. It is at this time that the operation should be done and by doing it in these selected cases, a marked improvement in the number and permanence of the cures has been secured. Sorrel has been able to trace 106 of his operative cases. Of these sixty were "excellent"; this means that the patients were able to pursue exactly the same mode of life as before the illness developed. Twenty-one were good, in that the patients were able to do almost everything that they did before; nine were fair, and sixteen were bad.

Sorrel does not believe that the graft has any definite effect in helping the absorption of abscesses, in closing fistulae, or in curing paraplegias. Madame Sorrel made a particular investigation of paraplegias in Pott's disease, and found that of eighty non-operated cases in which paraplegia was present, ninety per cent. recovered spontaneously.

Although differing from Albee in their critical conception of the action of the bone graft, the authors stress their indebtedness to him and describe his operation in detail. They have not employed the Hibbs method of fusion.

The report should be read in its detail by all those who are interested in the treatment of Pott's disease.—*Leo Mayer, M.D., New York, N. Y.*

THE RADICULAR SYNDROME IN HYPERTROPHIC OSTEARTHRITIS OF THE SPINE. ROOT PAIN AND ITS DIFFERENTIATION FROM HEART PAIN. Lewis Gunther and John J. Sampson. *J. Am. Med. Assn.*, XCIII, 514, Aug. 17, 1929.

This study concerns a group of fifty patients suffering from osteo-arthritis of the upper part of the dorsal spine, whose chief complaint was pain over the chest, and over the precordia in the distribution of the first to the fifth or sixth dorsal roots. The authors point out that the differential diagnosis of precordial pain of radicular origin from that of visceral origin is largely made on the basis of a careful history. Physical examination may reveal evidences of osteo-arthritis in peripheral joints. The spine usually shows restricted mobility. Objective sensory disturbances such as hyperaesthesia or hypoaesthesia were tested for and found in the majority of cases by means of the cotton-tuft

method. These sensory disturbances bore a fairly constant relation to the duration of symptoms. During exacerbations when the symptoms were of less than a year's duration, hyperaesthesia was the most constant finding, and generally hypo-aesthesia was found when the duration was longer than five years. The x-ray, fluoroscope, and electrocardiogram assist in diagnosing the presence or absence of organic heart disease. The relief of root pain by supports, physiotherapy, and sedatives, such as salicylates and phenobarbital was noted. Nitrites were used as a therapeutic test in the separation of the two types of pain,—giving no relief but instead a discomfort from dizziness in cases of root pain; whereas in the viscerosensory reflex of cardiac origin, the relief is well known. —*Leo J. Miltner, M.D., Iowa City, Iowa.*

Necrosis of the Distal Epiphysis of the Right Femur. Edwin F. Hirsch and Edwin W. Ryerson. *J. Am. Med. Assn.*, XCIII, 679, Aug. 31, 1929.

After a careful review of the literature, the authors add a case, the essential features of which are as follows: a white man aged twenty-seven years, had for seventeen years had some disease of the lower end of the right femur accompanied by inflammatory changes of the right knee joint. The symptoms were those of a mild arthritis, for which casts had been applied off and on during the entire course. Many diagnoses were entertained,—tuberculosis, bone cyst, gonorrheal infection, and sarcoma. X-ray pictures taken as early as six years before the last examination revealed extensive atrophy of the femoral condyles and upper part of the tibia with a few arthritic spurs. To establish a diagnosis, an exploratory operation of the knee was done, the entire lower epiphysis of the femur and the upper surface of the tibia being removed in toto. Histological pictures of the bone were characterized by marked atrophy and necrosis of bone, the necrotic spicules being embedded in myxomatous fibrous stroma. The soft tissues around the bone included some oedematous connective tissue with lymphocyte and plasma-cell infiltrations like those in the marrow spaces, and also masses of oedematous vascular chronic granulation tissue.

The authors discuss Axhausen's theories of epiphyseal necrosis due to bland anaemic infarcts by mycotic emboli, but they feel that this opinion is inadequate in explaining the progressive character of the lesion, except that the bacteria continue to grow and extend the region involved.—*Leo J. Miltner, M.D., Iowa City, Iowa.*

Postural Treatment in Bulbar Infantile Paralysis. Jay I. Durand. *J. Am. Med. Assn.*, XCIII, 1044, Oct. 5, 1929.

The author feels that in infantile paralysis of the bulbar type, many deaths are due to drowning from the profuse secretion of mucus in the throat and bronchial tubes which the patient can neither swallow nor raise,—this inability being due to paralysis of respiration and deglutition.

Two cases are reported, in both of which there was quite severe paralysis of respiration and deglutition. Postural treatment, *i.e.*, elevating the foot of the bed two feet and laying the patient on the face—along with ordinary methods of treatment, gave unexpected recovery. In both cases a large amount of mucus secretion drained from the nose and mouth immediately after lowering the head, and, from this time on, recovery was expected.

The author states that the paralysis in bulbar poliomyelitis generally clears up in a few days to two weeks.

Dr. E. B. Shaw and Dr. E. Friedman, in their discussion of the paper, agreed that postural treatment is a life-saving measure in cases where paralysis is not complete. —*L. J. Miltner, M.D., Iowa City, Iowa.*

Spinal Fusion Operations in the Treatment of Low Back and Sciatic Pain. Fremont A. Chandler, *J. Am. Med. Assn.*, XCIII, 1447. Nov. 9, 1929.

The author reviews twenty-nine cases of low back and sciatic pain which were operated upon in the service of Dr. Ryerson during the past five years. All were chronic and had

previously had sources of infection removed, manipulation, and other conservative measures in treatment. Seventeen were females, twelve males and were aged sixteen to fifty-three, with an average age of thirty-one and nine-tenths years. Average age at onset of symptoms in group was twenty-six and six-tenths. Trauma was associated in nine cases; two had onset during pregnancy.

Lumbar pain and backache was the outstanding symptom in every case. Sciatica was the chief complaint in nineteen out of the twenty-nine cases. Objective signs were not pronounced as in acute lesions, but the most constant was tenderness over sacro-lumbar region, and variation in the lumbar arc, of lateral motion. This arc was higher when bending away from the side of irritation, or toward the side with bone bloc, as by a sacralized process. Roentgenologic findings were positive and when associated with clinical symptoms formed the basis for diagnosis and treatment: sacralization of last lumbar vertebra in six; spina bifida occulta, four; irregular articulations, six; sclerosis of sacro-iliac joints in twelve; osteo-arthritis, six; increased lumbosacral angle in five. Some other abnormalities were noted in lesser numbers.

Hibbs' fusion was done at the sacrolumbar spine in eleven. The combined fusion of sacro-iliac and sacrolumbar spine was done in seventeen, by the author's method.

Postoperative treatment,—firm bed, no support. Recumbency for six to ten weeks. On getting up, a heavy fabric corset as routine and a brace in some cases.

Results: Fifteen cases had complete relief; nine had sufficient improvement to be pleased with result, but certain positions were uncomfortable; two were fair; two were failures; there was one death.—*W. B. Carrell, M.D., Dallas, Texas.*

Spinal Arthritis. Louis W. Allard. *J. Am. Med. Assn.*, XCIII, 1556, Nov. 16, 1929.

From personal experience, a review of the literature, and communication with industrial commissions and orthopaedic surgeons, the author is convinced that chronic arthritis in the spine is much more common than generally believed, and is a factor in recovery from many back injuries.

A disease of adults, and especially in hard working men who have had frequent traumas and have paid slight attention to foci of infection, the first symptoms are frequently noted after a back strain, or more serious injury. It is difficult to estimate the effect on convalescence by the arthritis, but injuries are invariably prolonged and many patients become permanently partially disabled following injuries from which normal persons would recover in a few weeks.

A suggestion is made that industrial surgeons and insurance companies study this phase of back injuries, that reliable data may be had to suitably classify cases and charge the disability to proper cause. Whether the hazard of occupation should carry all the responsibility, or the individual with spinal arthritis seek selective but less remunerative work, is a problem for consideration.—*W. B. Carrell, M.D., Dallas, Texas.*

Observations on the Results of Treatment of Scoliosis. A. E. Flagstad. *J. Am. Med. Assn.*, XCIII, 1623, Nov. 23, 1929.

In a study of 100 private cases and 150 treated at the State Hospital, it was observed that financial limitation made private cases less valuable, because frequently a sufficient number of x-rays were not available, and in many cases physiotherapy treatment was not followed as recommended. At the State Hospital a more standard plan has been followed, and all patients are started in treatment with exercises to improve deformity. After a period they are checked, and decision made as to whether they shall be given conservative or operative treatment.

A small series of cases were tried in each of the several methods used to forcibly correct the deformity. Success varied, not by the method used, but in proportion to the extent of rotation. Lateral deviations with little or no rotation may be changed, but those with well marked rotation were not corrected by any of the methods. When operation is to be done, the maximum of correction is obtained and a plaster applied to hold that position during convalescence. The operation through a window in plaster

is easily accomplished, and with a respiratory window added does not complicate the operation.

Operative procedure has a definite place in the treatment of scoliosis but is not a solution of the problem.—*W. B. Carrell, M.D., Dallas, Texas.*

A Procedure in The Management of Advanced Scoliosis. Philip H. Kreuscher. *J. Am. Med. Assn.*, XCIII, 1619, Nov. 23, 1929.

Correction of deformity and maintenance of correction are the problems in treatment. In advanced cases between the ages of fourteen and twenty the plan followed by the author is:

First: The ambulatory stage covering a period of several months. Jackets are applied in head traction, and changed every five or six weeks. Chest exercises are given in the jacket.

Second: In recumbent position longitudinal and lateral traction is applied, fifteen to twenty-five pounds for eight or ten weeks.

Third: After securing the maximum correction by these measures, the patient is anaesthetized and a jacket applied under traction. When the jacket position is comfortable, a narrow section is cut out about four inches wide through length of the spine and,

Fourth: Operation of fusion is done. Spinous processes are exposed and a section on concave side turned outward and thin tibial grafts, two to four inches in length, inserted in interlocking fashion from the seventh cervical to lower lumbar. This fusion includes the primary curve, the compensatory curve, and the section between the curves. Patient is placed on a Bradford frame and after several days traction is again applied and continued for six to eight weeks. Ambulatory jackets are reapplied at four or five months. Treatment period up to discarding jackets is ten to fourteen months.—*W. B. Carrell, M.D., Dallas, Texas.*

The Results of Ingestion of Certain Calcium Salts and of Calcium. C. S. Robinson, C. F. Huffman, and M. F. Mason. *J. Biol. Chem.*, LXXXIV, Oct. 1929.

The subjects were healthy male calves.

Serum calcium was raised by calcium chloride and calcium lactate plus lactose. It was slightly raised during the first part of the period of feeding lactose alone but then fell noticeably. The inorganic phosphorus of the blood was increased by bone meal alone and with lactose, and by lactose alone. It was reduced by calcium lactate alone and with lactose (increased fixation probably).

Only about ten per cent. of the calcium of the calcium chloride was retained in the body and probably not over thirty per cent. was absorbed at all. The administration of this salt caused a marked loss of phosphorus, exceeding the amount in the diet in those experiments. This loss was distributed between the urine and feces. About fifty per cent. of the calcium lactate was retained. In addition to this, its administration was accompanied by an increased retention of dietary phosphorus. About twenty per cent. of calcium and phosphorus of bone meal was retained. The simultaneous feeding of lactose with bone meal doubled the calcium retention from bone meal, but caused no change in calcium retention from calcium lactate. It doubled the phosphorus retention from the bone meal and increased to about the same degree the retention of dietary phosphorus under the influence of calcium lactate.

Although more marked in relieving tetany, calcium chloride has been shown to produce acidosis and its administration was accompanied by a marked drain on the phosphorus supply of the body. The lactate, on the other hand, increased the retention of both calcium and phosphorus.—*D. C. Keyes, M.D., Iowa City, Iowa.*

Immediate Surgical Treatment of Injuries of the Knee with Bone Lesions. Leriche and Girardier. *J. de Chir.*, XXXIV, 1, 1929.

The usual treatment of hemarthrosis of the knee has been aspiration and mobilization. But if the condition is accompanied by lesions which cannot be healed spontaneously, it is advisable to operate immediately. It is not easy to determine what cases

should be operated upon; x-rays should always be taken to eliminate bone lesions. In case the x-ray is negative, localized tenderness over torn ligaments or blockage of movements are important indications for operation.

Five cases are reported,—one with a torn patellar tendon, and four with torn crucial ligaments or semilunar cartilages. All of these joints were explored and the torn ligaments or cartilages were sutured or removed with uniformly good results.

Early operation is urged to prevent the arthritic sequellae which frequently follow these injuries and are attributed by the author to vasomotor disturbances. The authors use the inverted U incision with detachment of the tibial tubercle.—*J. A. Key, M.D., St. Louis, Mo.*

UNRECOGNIZED FRACTURES OF THE VERTEBRAE. M. P. Huet. *J. de Chir.*, XXXIV, 15, 1929.

In spinal injuries there may be a compression fracture of the body of the vertebra which is not accompanied by neurological symptoms or even marked clinical signs. And, contrary to general opinion, these so called mild fractures are frequent, especially in the dorsolumbar region. There may be little or no displacement, and one has only the symptoms of a local contusion.

Treatment is reduction by recumbency with extension and counterextension, or simple immobilization in a plaster cast for three months. If this fracture is not treated, a painful spine develops for which one is justified in fusing the involved area.

The relation of these unrecognized fractures to Kummel's disease is discussed, and the author does not accept the view that in Kummel's disease there has not been an immediate fracture of the vertebra. Two cases are presented.—*J. A. Key, M.D., St. Louis, Mo.*

POSTERO-LATERAL APPROACH TO THE FOREARM. F. M. Cadenat. *J. de Chir.*, XXXIV, 145, 1929.

The incision is used to expose the deeper layers of the dorsal region of the forearm, and is especially useful for removing a vicious callus between the two bones. With the forearm held in pronation, the skin is incised along a line extending from the anterior border of the external epicondyle of the humerus to the styloid of the radius. The aponeurosis covering the muscles is then incised and the muscles are separated by blunt dissection.

In order to expose the lower third of the radius, one passes posterior to the supinator longus. For the middle and superior thirds, one passes either between the extensor communis digitorum and the extensor carpi radialis muscles or between the two radial extensors. In the upper third it is necessary to preserve the deep posterior branch of the radial nerve.

A similar incision over the ulna is described and is much simpler, in that almost the entire shaft of the bone can be exposed, and muscles retracted to give a good view of interosseous membrane.—*J. A. Key, M.D., St. Louis, Mo.*

INDICATIONS AND RESULTS OF OSTEOSYNTHESIS IN POTT'S DISEASE. E. Sorrel. *J. de Chir.*, XXXIV, 439, 1929.

The author states that the great disagreement in regard to advisability of osteosynthesis in Pott's disease is partly due to the great variation in the gravity of the disease, and states that in children healing can occur after great destruction, while in adults the lesion is never cured by simple orthopaedic measures. The other reason is that we do not yet know whether the operation is palliative or really curative.

There is no doubt but that enthusiasm has led surgeons to promise miraculous results, which have not been realized. At the present time the majority of surgeons believe that the operation should not be done in children, but that it offers considerable progress in the treatment of adults. Contraindications are tuberculosis elsewhere, very pronounced deformity, and bad condition of the skin over the involved area.

It is questionable just when operations should be done; some surgeons hesitate to operate in the presence of abscesses or sinuses. Various types of operations are de-

scribed and illustrated. After the operation, the patient is kept recumbent at least six months.

In 106 cases the author had sixty excellent results, twenty-one good results in which patients were able to earn a living but the spine was not strong, nine mediocre results in which patients were not able to do regular work, and sixteen bad results in which the disease progressed. He concludes that the operative is the better method for the treatment of adults.—*J. A. Key, M.D., St. Louis, Mo.*

Calcification du Nucleus pulposus d'un Disque intervertébral. (Calcification of the Nucleus Pulposus of the Intervertebral Disc.) Marc Breton. *J. de Radiol.*, XIII, No. 5, May 1929.

The author shows a radiogram which resembles that described by Calvé and Galland in 1922, and which they have attributed to the calcification of the nucleus pulposus of the intervertebral disc. There is seen in the lateral view a lenticular biconvex shadow which occupies one-half the disc and is a little posterior to the center; on the antero-posterior view, the asymmetrical fragment nearly fills the width of the intervertebral disc. Three views (January 1926, February 1927, and November 1927) allow studies of the calcification of the nucleus and of the changes in the tenth dorsal vertebra.

The author then gives the clinical history of his case, and that of Calvé and Galland. In both cases the diagnosis was evidently made with ease, for the patients did not present symptoms of dorsal pain.

It is possible that the calcification of the nucleus pulposus is an anomaly well tolerated, and found by chance in patients suffering from back pain. It seems that the excessively rapid calcification, as shown by the x-ray, may be an actual pathological affection of the spinal column.—*R. de Cagny, Paris.*

Internal Derangements of the Knee Joint. Paul Bernard Roth. *Lancet*, Aug. 17, 1929.

The discussion is confined to injuries to the menisci, injuries to the spine of the tibia, and loose bodies. If any of these derangements are suspected the author does an exploratory operation, using a vertical incision in the mid-line which extends five inches above the patella and three inches below. He splits the patella vertically and continues the split up between the fibers of the quadriceps tendon and down between the fibers of the ligamentum patellae for the full extent of the wound. The wound is retracted and the knee flexed. The sub-patellar pad of fat is then divided down to the tibia, exposing the whole joint. The patella, the quadriceps, and the patellar ligament are closed with a continuous suture of chromic catgut. The skin is closed with interrupted horsehair. Only a dry dressing is applied and the patient starts motion on the third day, gets up with crutches the third week, and goes to work in six weeks.

Out of forty-one cases operated, seventeen had a split or detached medial meniscus; four had a split or detached lateral meniscus; ten had loose bodies; five had fracture of the spine of the tibia; four had normal joints, though injured meniscus was suspected; one had normal joint, though loose body was suspected.

The author advocates reduction under gas of displaced menisci. Only a second displacement warrants operation. He believes that operation for removal of damaged menisci done by this method, rather than by the lateral incision method, gives a perfect cure.

Although division of the patella may give rise to slight osteo-arthritic changes years later, he maintains that this is much less harmful than cutting the internal lateral ligament, and also that it gives a much better exposure.—*Ruth Jackson, M.D., Iowa City, Iowa.*

Un Caso Atipico di Condromatosi Articolare (An Atypical Case of Articular Chondroma). G. Giraudi. *Minerva Medica*, No. 27, 1928.

In this case, reported by Dr. Giraudi, of Milan, the x-ray examination shows near one epitroclear a formation which was removed later by the surgeon and which resembled

a supernumerary bone in both its x-ray and anatomical characteristics. The histological examination showed, on the contrary, that it was an ossifying chondroma, and it recurred as an articular chondroma.

THE PROBLEM OF THE CONTROL OF INFANTILE PARALYSIS. John Lovett Morse. *New England J. Med.*, CC, 1236, June 13, 1929.

The subject is taken up from the broad epidemiological viewpoint.

He states that it is justifiable to assume tentatively that a filterable virus is the cause and that the pleomorphic streptococcus of Rosenow is a secondary or concomitant invader. The virus does not penetrate the gastro-intestinal mucosa. The passive immunization with convalescent serum has hardly reached the experimental stage and is very scarce at any rate. In treatment, normal and immune serum have been used with conflicting results. Convalescent serum clinically offers no definite hope of doing good.—*Jacob Kulowski, M.D., Iowa City, Iowa.*

THE ASSOCIATION OF INTRA-THORACIC LESIONS AND SURGICAL TUBERCULOSIS. Harold Ragolsky. *New England J. Med.*, CCI, 11, July 4, 1929.

In this paper the author aims to show that pulmonary lesions associated with surgical tuberculosis do not appear very frequently, contrary to the general view held by the profession.

From the angle of a phthisiologist he reports from the literature as follows:

At one sanitarium of 1,058 cases of pulmonary tuberculosis only two and seven-tenths per cent. had bone and joint lesions. At another only one and three-tenths per cent. had bone and joint lesions. At still another of 4,654 cases seven per cent. had bone and joint lesions.

He therefore concludes that bone and joint lesions are not frequent in pulmonary tuberculosis.

From the surgical viewpoint the author analyzes 200 cases from his own clinic:

Of these, one in six showed positive pulmonary involvement. Of the rest, fifty-five per cent. showed intrathoracic lesions, not necessarily active.

He quotes again from the literature:

1. In 100 children with surgical tuberculosis, fifty-three per cent. showed lung evidences of the disease.
2. In thirty adult cases practically all had it.
3. One man reports that only four out of forty-six cases of surgical tuberculosis showed any pulmonary involvement.—*Jacob Kulowski, M.D., Iowa City, Iowa.*

VOLKMAN'S ISCHAEMIC CONTRACTURE. Frank D. Dickson. *New Orleans Med. and Surg. J.*, LXXXII, No. 3, Sept. 1929.

The author divided his cases of Volkman's contracture into two classes: The first is that in which there is the usual contracture with loss of function in the forearm, hand, and fingers, but with only moderate damage to the flexor muscles; the second type is that in which he finds profound damage to the flexor muscles. In the first type the primary pathology is in the nerves and by immediate proper treatment the prognosis is good. In the second type the prognosis is poor due to muscle destruction. The operation on the first type is discussed in some detail.—*E. S. Hatch, M.D., New Orleans, La.*

TRAITEMENT DES PARAPLÉGIES POTTIQUES. (Treatment of Pott's Paraplegia.) Jacques Calvé. *Notes pratiques d'Actualité méd.*, No. 86, May and June 1929.

Calvé reviews the various theories of the causation of paraplegia in Pott's disease, and states that the factor resulting in the compression is the abscess with caseous deposits of fungosities which is situated in the anterior extradural part of the spinal canal. It is of soft and plastic consistency, and is capable of developing a positively high tension. Blocked above and below by the adhesions between the dura mater and the intervertebral ligament, the compressed mass tends to be enucleated by this heaping up of the debris from destruction of the vertebral bodies. The cord becomes curved over the mass, and is crushed by the obstacle.

The early treatment should be orthopaedic—recumbency. To maintain progressive correction by plaster jackets is usually all that is necessary in children, and often in adults. In case of failure, it is necessary to resort to surgical means. Laminectomy has not proved effective. The author has proposed and practised puncture of the canal and evacuation of the abscess. He has used the method in twenty-seven cases. Sixty-seven catheterizations have been made, effective and without accident. In eleven cases there were seven cures and four failures. The author states that the method is simple, with very little danger and is very frequently effective.

OPERATIVE TREATMENT OF CONTRACTURES AND ANKYLOSES OF THE KNEE JOINT. Prof. R. Wreden. *Orthopedia i Travmatologia*, IV-V, 18, 1928.

The contractures are classified as arthrogenous, neurogenous, and scar contractures. The arthrogenous, whether muscular or associated with dislocation and deformity of the articular surfaces, always retain some motion; any operative treatment aiming to conserve this motion is, therefore, commendable.

The author proposes his operation, which he calls metaplasia. Two incisions are made through the soft tissues, one on each side of the suprapatellar synovial pouch, beginning at the condyles; they meet in the median line to be extended about one to one and one-half centimeters upward. The periosteum is then separated and the flap turned down. A transverse groove is then formed on the anterior surface of the femur above the epiphysis, the femur is divided two centimeters above the groove, and the proximal fragment of the divided femur is luxated into the wound and trimmed for insertion into the above mentioned groove. The entire extremity is extended, the periosteum united, the wound closed with catgut and immobilized in a plaster spica for six weeks. This procedure permits correction of the genu varum and genu valgum deformities also. The author obtained excellent functional and cosmetic results in his five hundred cases.

In the neurogenous contractures the treatment differs with the character of the affection. If the function of the flexors is satisfactory, three variations are possible: Simple flexion contracture requires a transplantation of the biceps, semitendinosus, gracilis, and sartorius into the patella; contractures complicated with genu varum or genu valgum require the metaplasia procedure with transplantation of the tendons; contractures with subluxation of the tibia are also treated, according to the author's technique, by transplantation of tendons. In spastic paralysis of central origin, Stofel's operation is indicated when flexion is possible up to 140 degrees and some motion of the knee joint is present. When the angle of flexion is below 140 degrees and the extensors are very weak, the tendons of the biceps, semi-tendinosus, gracilis, and sartorius are partially resected, the semimembranosus is left uncut to prevent genu recurvatum. When the rigidity of the knee is very marked, a transplantation of the biceps into the

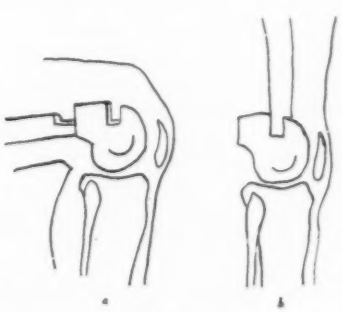

FIG. 1

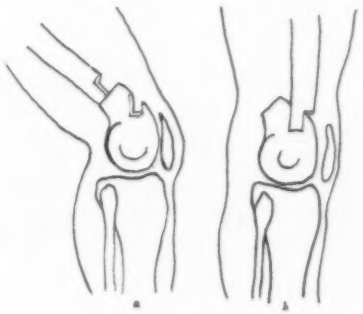

FIG. 2

Operative treatment of contractures

patella is advised. In the spinal type of spastic paralysis as observed after trauma, a laminectomy is indicated, sometimes combined with transplantation of tendons or peripheral nerves. Contractures produced by skin scars require plastic procedures.

The treatment of ankylosis of the knee is dictated by the degree of deformity and position. No treatment is required when the knee is fixed in extension. In flexion deformity, normal condition of statics has to be reestablished and arthroplasty gives a maximum of function. In tuberculous ankylosis the wise maxim of Ménard should never be forgotten: Tuberculosis never dies, it only slumbers to awaken from slightest shock. Arthroplasty is contraindicated; the author considers his procedure as the operation of choice, as it is performed within healthy tissues. In non-tuberculous ankylosis, arthroplasty secures the best results to the joint and entire extremity.

Arthroplasty is indicated in full extension ankylosis or in flexion when the angle of flexion is not less than 135 degrees. More acute flexion involves removal of too much bone, which increases the distance between the newly formed joint surfaces and subsequently leaves a weak joint. In these cases the author prefers solid ankylosis in correct position, which he secures by his operation, wedge osteotomy, or resection. —*Emanuel Kaplan, M.D., New York, N. Y.*

TREATMENT OF PSEUDARTHROSIS OF THE NECK OF THE FEMUR AND COXA VARA TRAUMATICA. Lörenz Bohler. *Orthopedia i Travmatologia*, VI, 9, 1928.

When callus does not form in fractures of the neck of the femur, the neck gradually disappears and the head wears off, the leg rotates outward and becomes shorter. Sometimes the head fuses with the acetabulum; abduction is then impossible, and the Trendelenburg sign is present. This sign is also present in coxa vara and congenital dislocation of the femur, and is explained by weakness of the glutei medius and minimus.

If the general condition of the patient permits it, the best treatment consists in subtrochanteric osteotomy after the methods of v. Baeyer, Lorenz, or Schanz. Just before the operation, the angle between the head and shaft of the femur is measured on the roentgenogram. Under lumbar anaesthesia a non-rusting nail, twenty centimeters long, is driven into the major trochanter, and another one of the same size is driven into the shaft six to eight centimeters lower and parallel to the first; between the two, through a longitudinal incision two centimeters long, an osteotomy of the femur is performed. In the presence of a strong adduction deformity, a subcutaneous tenotomy of the adductors is done. With the aid of the two nails, the distal fragment is abducted to twenty-five or thirty-five degrees. This can be done with great precision, as the angle between the osteotomized fragments is equal to the angle between the nails. The extremity is then immobilized in plaster or in a Brown's splint with traction for ten weeks, after which gradually increasing weight-bearing is permitted.

Epiphysiolysis of the head of the femur. Up to the age of seventeen years a corresponding trauma may produce a separation of the epiphysis. The upper part of the head slips downward; adduction and external or internal rotation are present. Sometimes the slipping of the head after trauma becomes gradually worse, causing a typical coxa vara deformity. In recent cases, reduction can be secured by strong rotation and traction under local or general anaesthesia, after which a fixation plaster is applied for from eight to ten weeks. In old cases, in the presence of malunion or pseudarthrosis of the neck, a subtrochanteric osteotomy is performed. Traction is then applied in preference to plaster. In eight to nine weeks the leg is ready for weight-bearing. Attempts at reduction by abduction and internal rotation in old cases lead to an accentuation of the head luxation, with occasional crushing and subsequent ankylosis of the hip joint.—*Emanuel Kaplan, M.D., New York, N. Y.*

ISOLATED FRACTURE OF THE TROCHANTER MINOR. N. Gladirevsky. *Orthopedia i Travmatologia*, VI, 115, 1928.

This fracture occurs very rarely, but possibly more frequently than is known. In 1928 Lewin published his observations, having gathered from the literature forty-five

cases. The author describes a fracture of the trochanter minor, found on x-ray examination, in a boy sixteen years old. Direct trauma or muscular contraction may be responsible for its production. The trochanter is as a rule displaced upward from one to several centimeters; it seems that the periosteum is dragged with it without being torn. This is an important point and explains early union.

Local pain and swelling in the ileopectineal fossa and the position of the extremity have only a limited significance. Ludloff's sign is more important: when positive, the patient cannot flex his thigh while sitting; flexion is, however, possible when the patient is lying. The diagnosis is difficult and the last word belongs to roentgenography. The prognosis is good in young subjects; in old patients the prognosis is similar to the fracture of the neck of the femur. The different methods of treatment proposed all proved to be good. The author believes it sufficient to keep the young patients in bed for two to three weeks.—*Emanuel Kaplan, M.D., New York, N. Y.*

Appareils Plâtrés à Chambre Libre (Plaster Apparatus with a Free Space). Ducroquet, Jr. *Presse Méd.*, No. 50, June 22, 1929.

The plaster is applied to the limb, and one side made larger by placing a pad within the plaster. When dry, an opening is made, the pad is removed, and the free space thus left allows either the replacement of the malposition which may be obtained by the progressive pressure on this segment of the limb in the open space, by successive corrections, or limited mobility within this free space.

The results obtained in the rachitic deformities of the knee of varus and valgus in children were constant. No attempt is made for correction of the severe deformities by this method. The progressive reduction by means of the application of a plaster spica with this free space is completed in about six to eight weeks. For a month following, the author then employs a celluloid or a plaster trough, combined with intensive general treatment for the recalcification, and also with gymnastics. Without reduction the general treatment would only result in a recalcification of the bones without correction of the deformity. This method is used up to the age of about twelve (Broca, Ombrédanne), and osteotomy is delayed until after this period. This treatment is applicable to deformities of the varus or valgus *"bacillose"* in children,—flexion of the knees in the young resulting from infantile paralysis or from tuberculosis.

In cases of stiffness of the joints, where mobilization provokes a reaction, the limb is placed in plaster by the same method, in alternately the position of extreme flexion and extreme extension for four or five hours. The stretching or distension by this method is much quicker than by the violent stretching, and this method of using the free space in the plaster allows a limited amount of mobilization, avoiding the stiffness of ankylosis.

In congenital dislocation of the hip, it allows a stability of the reduction and allows also the active movement of the hip which of itself counteracts the development of the stiffness and avoids the vicious attitudes which are so apt to result from the immobilization which is necessary to insure the remolding of the cotyloid cavity.

The author has treated 100 cases. This method is less prolonged, and gives better results than the ordinary orthopaedic treatment. It lowers the limit of age for the bloodless reduction.—*R. de Cagny, Paris.*

The Value of Osteosynthesis in Closed Fractures of Both Bones of the Leg. Patel and de Grandieu. *Presse méd.*, XXXVII, No. 68, 1929.

Out of fifty cases operated on from 1924 to 1926, twenty-eight were followed long enough to be checked up.

Conclusions are:

(1) The osteosynthesis does not shorten the time necessary for the consolidation.

(2) Anatomical result: perfect in eighty-four per cent; this includes the normal shape and length of the leg. From this point of view the osteosynthesis is the best procedure.

(3) Functional result: in eighty-six per cent. of the cases the tibiotarsal joint recovers entire motion. In seventy-eight and five-tenths per cent. the gait is perfect even for fatigue, and running is also possible.

(4) From the trophic point of view—*i.e.*, muscle atrophy, slight circulatory disturbances, etc.—osteosynthesis is on the same plane as the other procedures.

(5) From the legal standpoint, the osteosynthesis does not shorten the period of inability to work.—*R. Soeur, M.D. (Belgium), Iowa City, Iowa.*

LES FRACTURES ISOLÉES FERMÉES DES APOPHYSES TRANSVERSES LOMBAIRES. (Closed Isolated Fractures of the Transverse Lumbar Process.) J. Chavannaz. *Rev. de Chir.*, LXVII, No. 1 and No. 2, 1929.

The closed fracture of a single transverse process of the lumbar area is relatively frequent. The author reports 128 cases, five of which are from personal observation. It is not possible to estimate the relative frequency of these fractures associated with injuries of the spine; they occur usually in men between twenty and forty-five years of age and in certain occupations, particularly mining. The causes differ widely. The author gives the list as: from direct violence, seventy-five; indirect, eight; muscular contraction, nine; miscellaneous (undetermined), three.

The fractures are: multiple, thirty-three cases; bilateral, six. The displacement varies according to the process involved. Callus forms if the fragments are not too widely separated. There may be associated lesions,—fracture of the vertebral bodies (the principal lesion), fracture of the twelfth rib, nerve lesions either immediate or late.

The symptoms vary, and may be severe or slight. The principal symptoms are pain (spontaneous), stiffness, mal-attitude of the spine, contraction, and disturbances of function. In the severe forms it is necessary to eliminate luxation of the spine, fracture of the vertebral bodies, fracture of the bodies associated with the transverse processes, and torsion of the spine. In the less severe forms, lumbago and muscle ruptures are to be considered. When seen late, the differentiation from chronic affections of the spine may be difficult (tuberculosis, spinal anomalies, etc.), and also sometimes from visceral disorders.

The prognosis is usually good, but sometimes partial disability remains from pain, rigidity, etc. Fractures of the fourth and fifth lumbar vertebrae are the most serious. Recovery in the majority of cases follows several weeks' rest in bed. Operative treatment is indicated only in persistent pain. Resection of the process is simple and gives good results.—*R. de Cagny, Paris.*

KYSTE HYDATIQUE DU RACHIS. (Hydatid Cyst of the Spine.) H. L. Rocher. *Rev. d'Orthop.*, XVI, 138, Mar. 1929.

The author reports from a personal case the observation and study of hydatid cyst of the spine.

The most frequent locations are apparently in the dorsal and sacral regions, usually in adults. Rocher's case was in a girl of thirteen. Paraplegia developed suddenly, and clinical and x-ray examinations showed the presence of a hydatid cyst in the right thorax, with evidence of destruction of the vertebral ends of the fifth and sixth ribs and loss of shadow on the right side of the pedicle of the fifth and sixth dorsal vertebrae; eosinophiles, four per cent., Weinberg slightly positive.

The cyst was evacuated, and the lateral surface of the spine appeared eroded. The dura mater was exposed over a distance of two and a half centimeters. The paraplegia disappeared immediately; the sinus persisted for thirteen months; recovery was complete seven months later.

The hydatid cyst may be the only sign of the echinoccus, or it may exist with other manifestations. The frequency of location in the spine varies from eight in fifty-two cases (Gangolphe), to forty-two in fifty-four (Kersente). According to Kersente, the

parasite develops more often in the vertebral body; according to Baqué, in the cord, and penetrates secondarily into the canal. The meninges may be involved by a pachymeningitis, and the compression of the nerve roots always precedes that of the cord. There may be a close clinical resemblance to Pott's disease; the exterior cysts simulate the abscesses. Their development is slow until the appearance of the involvement of the nerve roots and paraplegia. The paraplegia is spasmodic, generally develops slowly, but may appear suddenly.

To the clinical and x-ray evidence, the laboratory findings form the essential elements for positive diagnosis. The prognosis is grave; it depends upon early diagnosis, location, and extension of the disease.

The only treatment is operative; location of the cyst (radiographic and radiolipiodol) is the guide as to the route of operation. The cyst in the mediastinal area must be reached by costal resection or resection of the costotransverse process. Laminectomy may be necessary.

Susbielle, in his thesis (Le Kyste hydatique du Rachis, Sacrum excepté, Bordeaux, 1928), gives the results of operative treatment as follows: In forty-five cases, sixteen were operated upon, with nine deaths and seven cures. The later results have not been published, except in one case, but this case cannot be used for comparison with operative results.—*R. de Cagny, Paris.*

Arthritis Deformans. Diagnosis, Treatment, and Rehabilitation. William S. Baer. *Southern Med. J.*, XXII, 873, Oct. 1929.

Classification: (1) Infectious Type; (2) Atrophic Type; (3) Hypertrophic Type.

The author believes that type 1 is caused by micro-organisms,—probably a non-hemolytic streptococcus. There is something besides the infection which causes this type of arthritis. He expresses it as infection plus *X* equals infectious arthritis. Just what *X* is, is not definitely known. Heredity plays some part. A thorough survey of the entire body should be made. An endeavor is made to obtain a pure culture of the causative organism by blood culture, by joint aspiration, or by lymph node culture. He claims that sixty-six per cent. pure cultures were obtained from lymph nodes in cases of the infectious type. The technique of lymph node culture, and preparation of a vaccine are described. After all foci of infection are removed, the vaccine treatment is given. Beginning with a small dose, it is gradually increased, giving an injection every fourth day until twelve to sixteen are given, then after a rest period of six weeks a second series is given. One strives to get a definite constitutional reaction. He gives forced feedings and no restrictions of diet, fresh air, sunshine, and moderate exercise and passive motions. He says seventy-five per cent. of these patients so treated give gratifying results.

In the atrophic type the lesion is similar to the infectious, only more severe. The author believes ninety per cent. of the atrophic type are the end result of the infectious type not treated. About ten per cent. begin as an atrophic type. The etiology is probably the same but the causative organism is much more difficult to find. Only five per cent. of the lymph node cultures were positive. The treatment is similar to that of infectious arthritis if an organism can be found.

The hypertrophic type occurs in older people, and has entirely different pathology, etiology, and symptomatology. Etiology is divided into (1) heredity, (2) food, (3) trauma, (4) exposure. The disease is a dietary problem and not a bacteriological one.—*F. G. Hodgson, M.D., Atlanta, Ga.*

Gonococcus Arthritis—A Study of Six Hundred Ten Cases. Heinrich L. Wehrbein. *Surg., Gynec. Obstet.*, XLIX, 105, July 1929.

The author made a statistical study on the above subject. He classifies seventy-one cases as mild, 294 moderately severe, 217 severe, and twenty-eight very severe. Fifty-two per cent. occurred from one to twenty days following the primary infection and eighty per cent. within two months following the primary infection. 410 patients had

multiple joint lesions. 244 joints of the upper extremity were involved and 995 of the lower extremity. The joint most frequently involved was the knee, 409; next, ankle 340; foot, 118; wrist, 101; hip, 77; heel, 63; toes, 51; shoulders, 49; elbows, 35; and fingers, 34. The spine was affected eighteen times.

An attempt was made to demonstrate the influence of occupation to localization of the arthritis, but was unsuccessful.

Many forms of treatment were tried without unusual success. Casts were applied to 144 joints for the relief of pain, with relief in almost all cases. The average time of immobilization was ten days. The author believes that motion may be endangered by fixation, and advocates early active motion of the joints.—*E. M. Cowart, M.D., Iowa City, Iowa.*

Separation of the Symphysis Pubis. Joseph G. Wishner and Leo Mayer. *Surg., Gynec. Obstet.* XLIX, 380, Sept. 1929.

The authors report five cases of separation of the symphysis pubis following difficult labors. They believe that the separation is due to a stretching of the pubic ligaments rather than a tear of the ligaments.

To study the effect of separation of the pubis upon the sacro-iliac joints, the pubis of a cadaver was separated four centimeters. It was observed that the anterior sacro-iliac ligaments gave way; the anterior portion of the right sacro-iliac joint gaped open about three-eighths of an inch and the left about one-quarter of an inch.

The treatment recommended is circular compression of the pelvis by a canvas swathe which encircles the pelvis and to which ten to twenty pounds of weight are attached at each end. The pubis was gradually forced into its normal position within one to three weeks. Then the patients are fitted with a special corset which has a strong band beneath the anterior superior spine.

Five cases are reported in which good results were obtained by this treatment.—*E. M. Cowart, M.D., Iowa City, Iowa.*

Non-suppurative Infectious Osteomyelitis of Femur Simulating Osteogenetic Sarcoma. Clinic of Dr. Chas. Murray Gratz. *Surg. Clinics of North America*, IX, No. 3, June, 1929.

This case illustrates the great difficulties in the early diagnosis of bone tumors. The patient had had osteomyelitis of the distal phalanx of the index finger. Four weeks later he noticed pain in the lower third of the left thigh and had a temperature of 99.4 degrees. Two Wassermanns were negative. The x-ray showed a moth-eaten zone of destruction in the shaft about three inches in length, with periosteal thickening. A diagnosis of osteogenic sarcoma was made, with a Ewing tumor as a secondary diagnosis. X-rays of lungs and other bones were negative. The diagnosis, however, was still uncertain, so a biopsy was done nine days later. The periosteum was found to be very much thickened and congested with evidence of bone proliferation. The cortex was moth-eaten with areas of decalcification. The medullary cavity was increased in size and no signs of acute inflammation were noted. Microscopically the tumor simulated a sarcoma.

The pathologist's first opinion was that of malignancy. However, further slides were prepared and gone over by Dr. James Ewing, who made the diagnosis of a non-suppurative infectious osteomyelitis, which diagnosis the first pathologist later confirmed.

Coley's toxins and x-ray therapy were given before the pathological reports were obtained. After seven months the patient returned to light work.—*Ruth Jackson, M.D., Iowa City, Iowa.*

Du Rôle de la Chirurgie dans le Traitement de la Tuberculose Ostéo-Articulaire. (The Rôle of Surgery in the Treatment of Tuberculous Osteo-Arthritis.) J. Calvé. *La Vie Méd.*, 1253, Nov. 25, 1928.

Dr. Calvé has discussed at length a most important phase in the treatment of joint tuberculosis, and from his large experience, is most fitted to present the different theories

and practices which are in evidence and to comment upon them. He calls attention to the fact that the question of operative or non-operative interference is one of the most important decisions and that rather extreme views are held by the adherents of the two methods of treatment. Following the treatment of Ménard, of Lannelongue and Vernueil on the general character of this form of tuberculosis, he insists upon the need of prolonged and thorough rest. There has developed an operative tendency in very many countries, and many times it has seemed rather a dangerous tendency toward extensive and frequent operations; he discusses the different arguments which can be used on this subject. The operative procedures are directed mainly toward the elimination of a focus itself, toward the correction of deformities of the healed lesion; and the prosthetic, which may be regarded in a way as therapeutic, intended to aid or hasten the other treatment,—as spinal ankylosis or arthrodesis during the course of disease. He also states that there are some of these questions which can be considered as generally agreed upon and in which experience has already indicated the course to be followed, but there is the series of cases which may be called those of disagreement, in which the operators and the conservatives are widely separated in their opinion as regards treatment. These differences of opinion are centered mainly about those conditions which have to deal with a pure osteo-arthritis, closed, without fistulae, and have mainly to do with the decision as to the ankylosis or arthrodesis, either early or late. He quotes the opinions of the earlier observers, Lannelongue for instance, who insisted upon the importance of recognizing the general character of the joint tuberculosis, the need of prolonged rest and hygienic surroundings, including heliotherapy, and on the fact that these cases yield so successfully to this method. The operators, on the other hand, insist upon the early operation, and into this question the element of the so called social argument frequently enters. He discusses the question of whether there is such a thing as one treatment for the rich and another for the poor, and agrees that frequently there must be. As to the question of tuberculous arthritis in the knee of adults, he agrees that the treatment of this should be resection. Operative treatment of sequestra is in his opinion somewhat influenced as to whether they are the type discovered by x-ray without clinical symptoms, or whether they produce clinical manifestations. He also discusses the question of operation on the extra-articular foci, and calls attention to the dangers that are associated with and the results which follow this procedure. His ideas of the treatment of infected fistulae of tuberculosis are practical, sane, and helpful; he calls attention clearly to the fact that these infected fistulae, either from staphylococcus or streptococcus, find a particularly fertile ground for their development because of the modification of the tissues which has been brought about by the early tuberculous infection. He also advises against the operation except when absolutely necessary, but at such time the incision should be large and open, and with copious drainage. He states that in regard to the treatment of the closed tuberculosis (without fistulae), he follows the treatment of his former teacher, Ménard, and is a conservative, but yet at the same time an opportunist. He emphasizes again the results which can be obtained by the treatment of rest and heliotherapy and nourishment. He answers the objection made by many of the non-operators who have argued that there is a marked tendency to dissipate the infection, and states from his long and large experience that he practically has never observed this occurrence. His opinion and his conservative attitude in regard to the ankylosing operations on the spine are based on many of the unfortunate results which he has seen follow this procedure. He places himself as opposed to this operative occurrence in tuberculosis of the spine in children, but as partisan on the other hand for this operation with the adult, but holds that it should be performed only in the stage of convalescence, and instead of the long graft, advises the use of the short graft, applied only to the vertebrae affected. He favors arthrodesis in the case of hip disease by the extra-articular method, provided the operation does not interfere with an old or open focus. He states strongly that tuberculous osteo-arthritis should not be regarded as a surgical disease, neither as a local, but it should be remembered that osteo-arthritis is a general disease of slow development, a special

infection which demands particular climatic conditions, most careful orthopaedic treatment, and is not well cared for by the "surgical temperament". It demands particular care, with special reference to the medical problems, sometimes to the surgical, always with special patience of the former. He makes the statement that the treatment of tuberculous osteo-arthritis is essentially medical, is orthopaedic by necessity, and surgical by accident.

TIEREXPERIMENTELLE STUDIEN ZUR FRAGE DER PATHOLOGISCHEN ANATOMIE DER ADOLESZENTENKYPHOSE (Animal Experiments on the Question of the Pathologic Anatomy of the Adolescent Kyphosis). C. Mau. *Ztschr. f. Orthop. Chir.*, LI, 106, 1929.

Mau, who has already written several important papers on the question of adolescent kyphosis, has here published his animal experiments and comes to very interesting conclusions. He has sewed the end of the shortened tail of a young rat beneath the skin, making a marked curve; thus it was possible to obtain an actual kyphosis. The animals were killed and examined after different intervals. He found the following changes in the epiphyseal cartilage: at the concave side, irregular proliferations and limitation of the growth of the bone; the cranial epiphysis was always more affected than the caudal one; the diaphysis showed reactive new formation of spongious trabeculae, formation of typical edges or proliferations like those in arthritis deformans; the body of the vertebra is changed to a wedge-like shape with the point toward the concave side. The changes of the epiphyses consisted of functional adaptation,—enlargement of the lamallae and decrease of the marrow spaces; moreover, pressure atrophy of the concave side of the epiphysis, with finally complete disappearance at the concave side. The remnants of the epiphysis show total necrosis of bone and marrow. Mau believes that damage to the circulation leads to those remarkable changes which so much resemble those seen in the roentgen plates in cases of adolescent kyphosis.—*C. H. Bucholz, M.D., Halle, Germany.*

EPIPHYSENSCHÄDIGUNG BEI NAGELEXTENSION IM KINDLICHEN ALTER. (Epiphyseal Injury in Pin Extensions in Childhood.) Franz Koch. *Ztschr. f. orthop. Chir.*, LII, 1 Heft, 89, 1929.

If in extension with pin or nail the epiphyseal disc of a growing bone is injured, there will result either increased length growth or premature ossification with consequent shortening. The obliquity of the epiphyseal line at the lower end of the femur renders the lateral portion of the disc liable to such trauma. The medial portion of the epiphyses may grow normally and a valgus knee will result. The epiphyseal line should be sedulously avoided in skeletal extension, which is being practiced even more widely. Three cases in point are reported.—*J. E. Milgram, M.D., Iowa City, Iowa.*